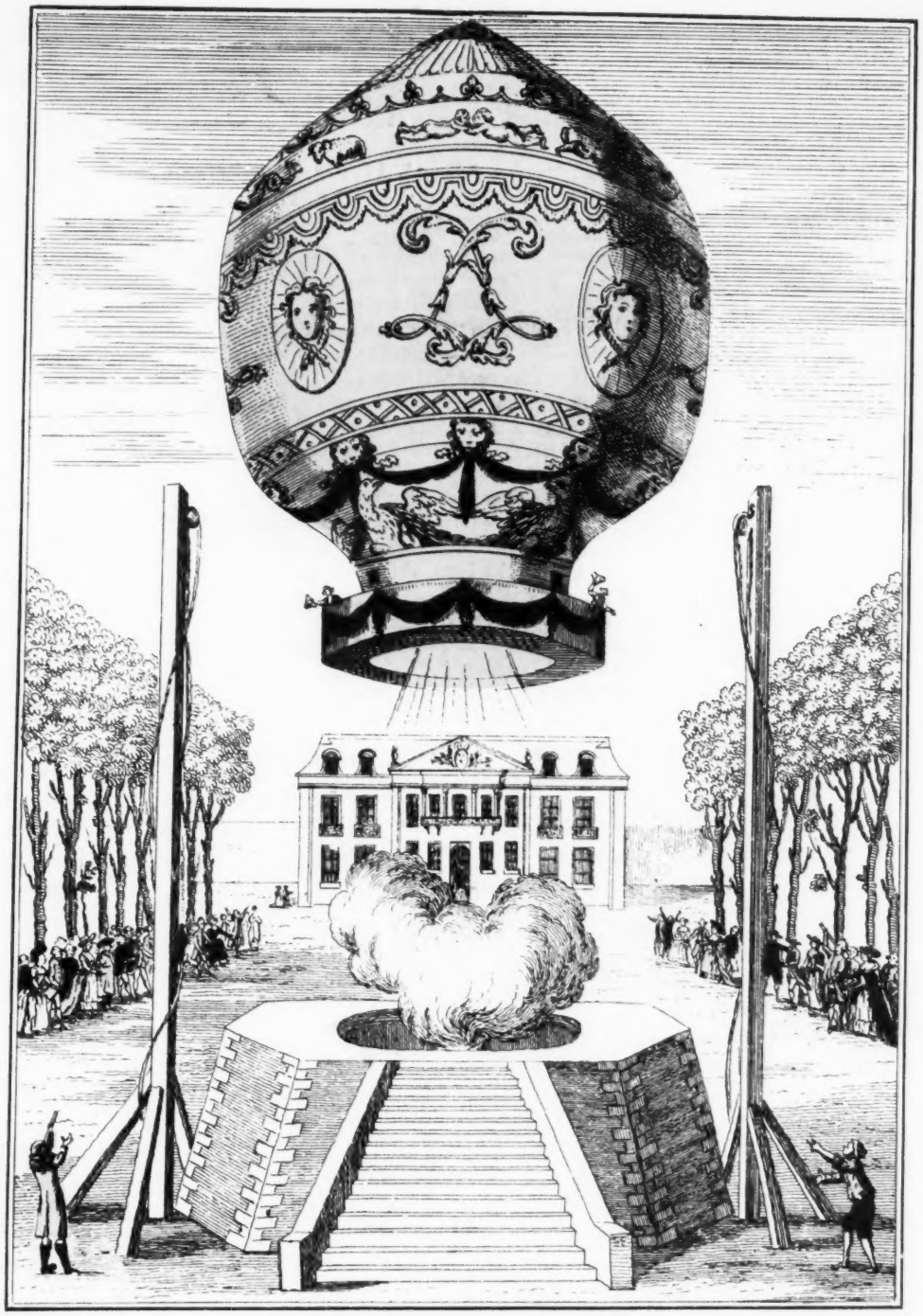

the Cornell engineer

COLLEGE OF ENGINEERING
DECEMBER, 1958 VOL. 24, NO. 3
CORNELL UNIVERSITY
25 CENTS

He's making sure that "C" rations don't spoil

The tin coating on "C" ration cans does not have to be thick—but it is important that it be evenly distributed to give sure protection for the contents. But how can you measure and inspect a coating that's almost as thin as a shadow?

U. S. Steel does it with the unique X-ray gage you see in the picture. A beam of X-rays is directed at the tinplate. The rays penetrate the tin coating and cause the iron atoms in the steel *base* to fluoresce and emit X-rays of their own. As these new X-rays emerge from the base, they are partially absorbed by the tin coating. The X-rays finally leaving the tin are measured by a geiger counter and this reveals the amount of absorption and, therefore, the coating weight.

Research work like this is one of the factors that accounts for the consistent high quality of all types of steel made by United States Steel.

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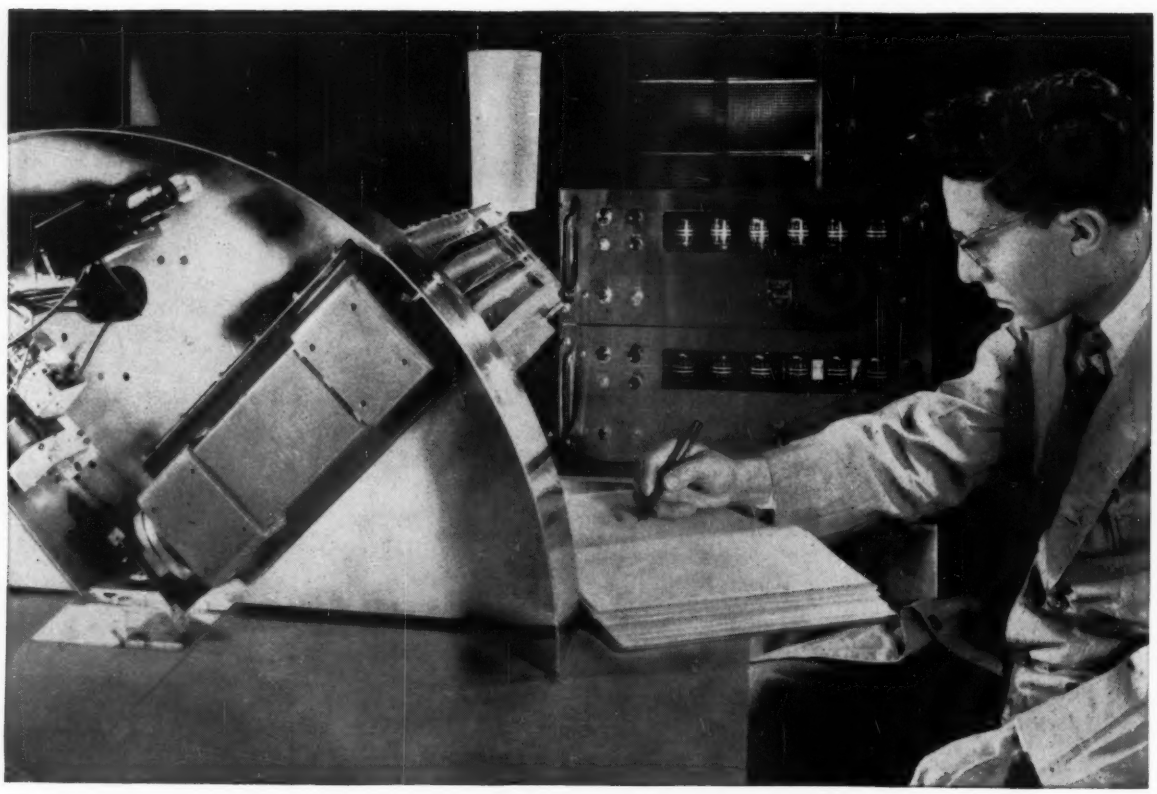
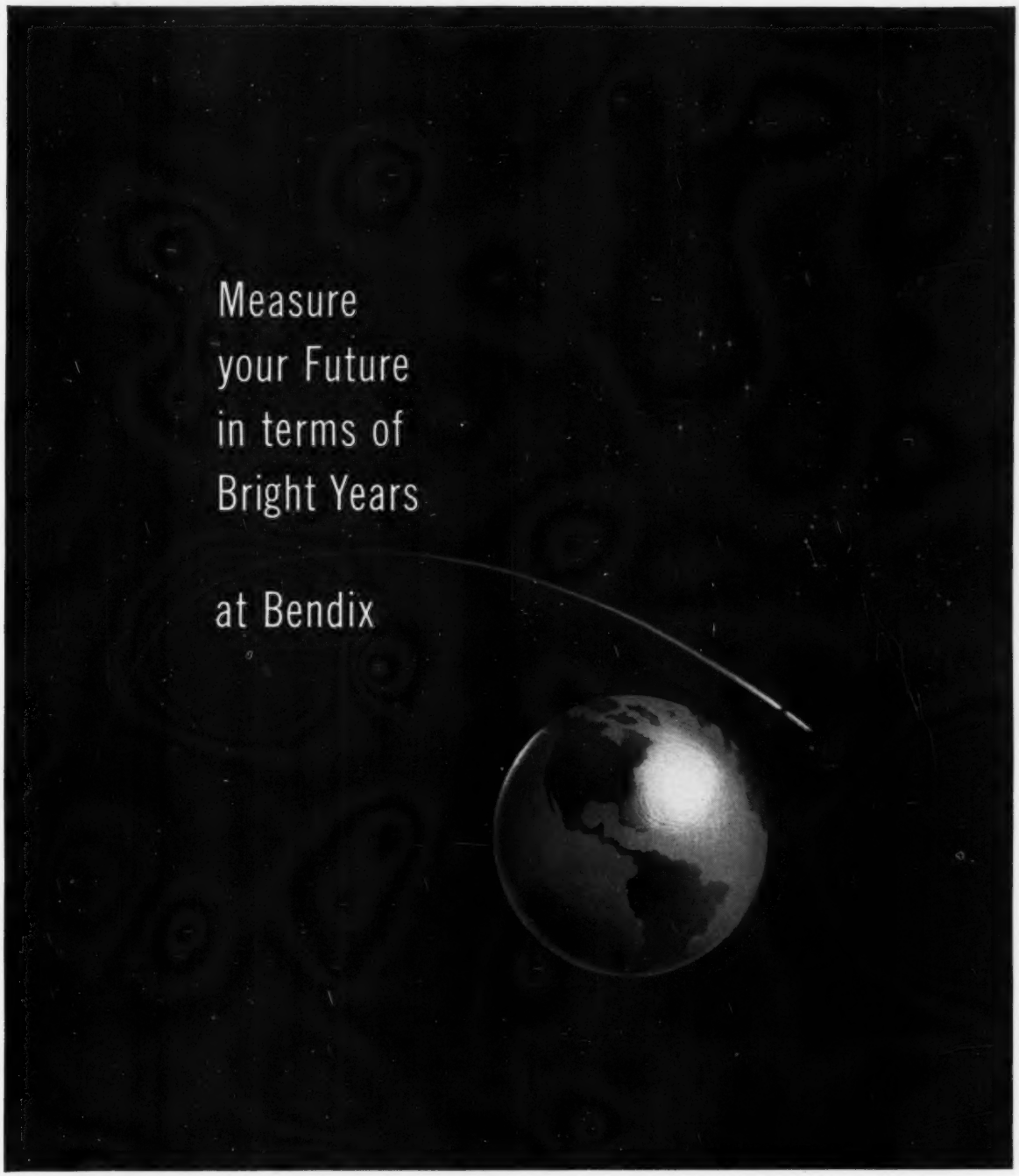


USS United States Steel



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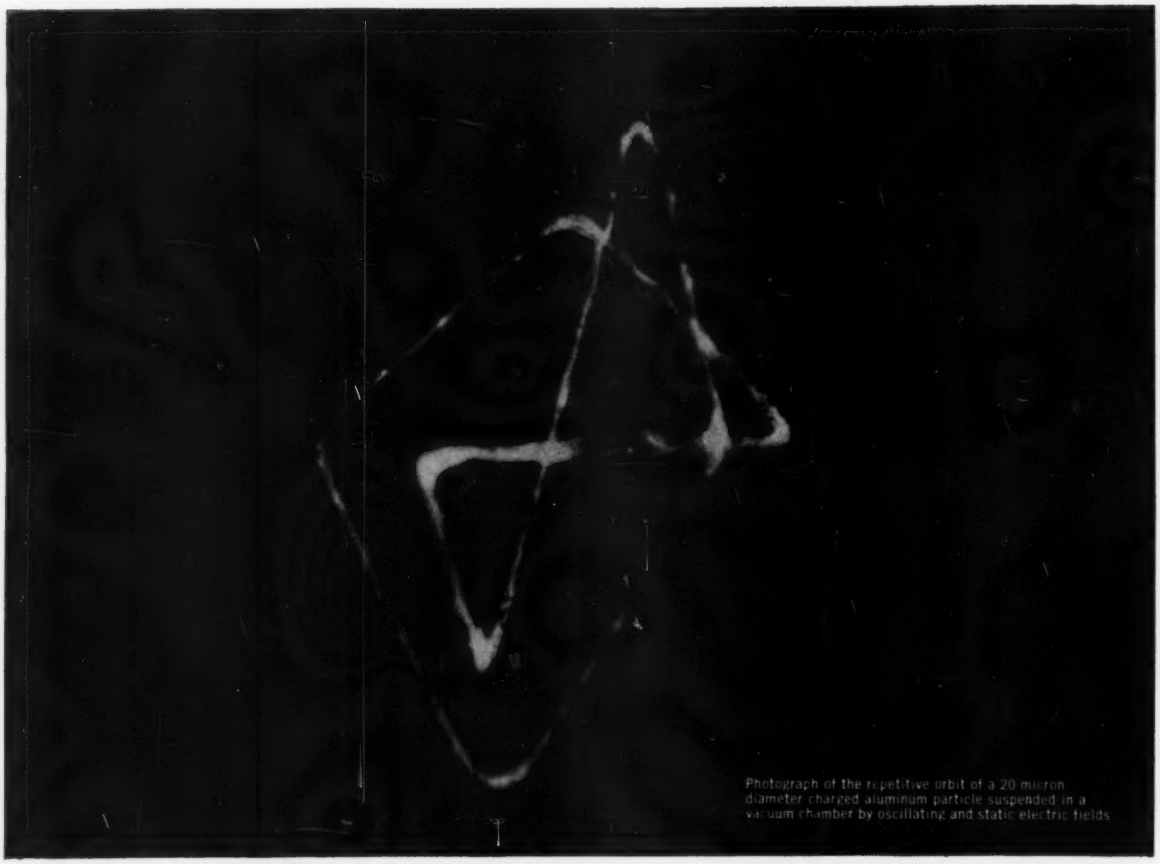

Photograph of the repetitive orbit of a 20 micron diameter charged aluminum particle suspended in a vacuum chamber by oscillating and static electric fields.

ELECTRODYNAMIC ORBITS

By the application of properly chosen alternating and static electric fields, electrically charged particles can be maintained in dynamic equilibrium in a vacuum against interparticle and gravitational forces. This is illustrated in the above photograph of the orbit of a charged dust particle. During the time of exposure the particle traversed the closed orbit several times, yet it retraced its complicated path so accurately that its various passages can barely be distinguished.

The range of particles of different charge-to-mass ratios which can be contained in this manner is determined by the gradients of the static and alternating electric field intensities and by the frequencies of the latter. In the absence of static fields and for a given electric field strength, the minimum frequency required for stable containment of the particles is proportional to the square root of their charge-to-mass ratios. Thus, charged colloidal particles require the use of audio frequencies, atomic ions need HF frequencies, while electrons require the use of VHF and higher frequencies.

Under the confining influence of the external fields, the particles are forced to vibrate with a lower frequency of motion which is determined by the external field intensities, space charge, and the driving frequencies. If the initial thermal energy is removed, a number of particles may be suspended in space in the form of a crystalline array which reflects the symmetry properties of the external electrodes. These "space crystals" can be repeatedly "melted" and re-formed by increasing and decreasing the effective electrical binding force. These techniques offer a new approach in the study of plasma problems and mass spectroscopy in what may be properly termed "Electrohydrodynamics."

At The Ramo-Wooldridge Corporation, work is in progress in this and other new and interesting fields. Scientists and engineers are invited to explore current openings in Electronic Reconnaissance and Countermeasures; Microwave Techniques; Infrared; Analog and Digital Computers; Air Navigation and Traffic Control; Antisubmarine Warfare; Electronic Language Translation; Radio and Wireline Communication, and Basic Electronic Research.

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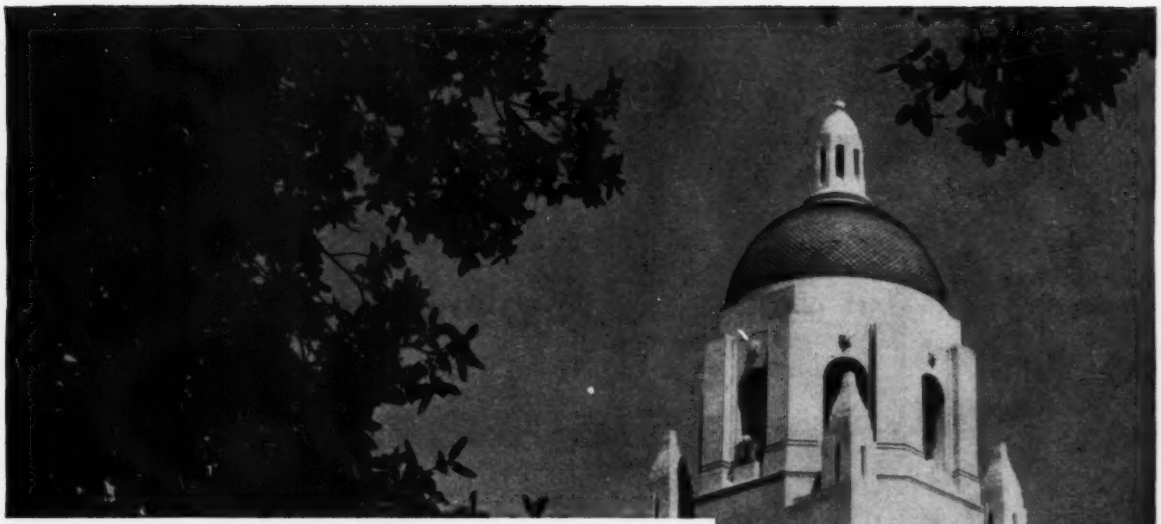

Why Lockheed –

Lockheed's leadership in aircraft is continuing in missiles. The Missile Systems Division is one of the largest in the industry and its reputation is attested by the number of high-priority, long-term projects it holds: the Polaris IRBM, Earth Satellite, Kingfisher (Q-5) and the X-7. To carry out such complex projects, the frontiers of technology in all areas must be expanded. Lockheed's laboratories at Sunnyvale and Palo Alto, California, provide the most advanced equipment for research and development, including complete test facilities and one of the most up-to-date computing centers in the nation. Employee benefits are among the best in the industry.

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Lockheed Missile Systems Division was recently honored at the first National Missile Industry Conference as "the organization that contributed most in the past year to the development of the art of missiles and astronautics."

For additional information, write Mr. R. C. Beverstock, College Relations Director, Lockheed Missile Systems Division, Sunnyvale , California.

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Alfred North Whitehead...on the passion for discovery

"Disinterested scientific curiosity is a passion for an ordered intellectual vision of the connection of events. But the goal of such curiosity is the marriage of action to thought. This essential intervention of action even in abstract science is often overlooked. No man of science wants merely to know. He acquires knowledge to appease his passion for discovery. He does not discover in order to know, he knows in order to discover. The pleasure which art and science can give to toil is the enjoyment which arises from successfully directed intention. Also it is the same pleasure which is yielded to the scientist and to the artist."

—The Aims of Education, 1917

THE RAND CORPORATION, SANTA MONICA, CALIFORNIA

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Prelude to space
The U. S. Air Force's LOCKHEED F-104A STARFIGHTER, fastest production airplane in the world, is one of the current crop of military aircraft whose extreme speeds and operating altitudes typify the problems of projecting man into space and keeping him alive. HAMILTON STANDARD designs and builds the air conditioning, engine fuel control and engine starter equipment for the F-104A and other leading supersonic aircraft. This experience is now being used as the springboard for investigations into the problems of environmental control for human survival in space.
USAF
The refrigeration package shown at the right which Hamilton Standard builds for the F-104A has the capacity to cool a seven to nine room house and weighs only 50 lbs.
If you are interested in sharing in the [illegible] will help make possible man's new age of flight, contact:
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Letters to the Editor . . .

To the Editor:

As a member of the Board of Trustees and as a member of the Engineering Council I would like to congratulate you upon the awards which you received at the Convention of the Engineering College Magazines Association. Frankly it was not surprising to me to read about the awards because of my own personal feeling about the excellence of your magazine. I believe I wrote you in particular about one of your issues last year.

May you continue with your good work in producing this excellent publication which brings such great credit to the College of Engineering at Cornell.

Frederic C. Wood '24

To the Editor:

Since 1909 I have seen every issue of the Cornell Civil Engineer and its much improved successor THE CORNELL ENGINEER. In those early days there was also a Sibley Journal, somewhat more pretentious than its counterpart. This was but natural considering the larger enrollment of Sibley College.

Now—after almost half a century, ensconced in the calm exile of retirement there is time to reflect on what has happened in the intervening years as indicated in the October number of the CORNELL ENGINEER.

The numerous, attractive advertisements eloquently outline the technological revolution that is still in progress, because many of them relate to industries that did not even exist in the 1910's. They also seem to imply an urgent, competitive demand for the graduating engineer. This bears out the alleged current shortage of engineers about which so much has been said of late. Except for certain narrow segments of the profession there is reason to doubt the validity of the emergency. There is indeed, just as there always has been and always will be a tremendous demand and opportunity for the outstanding individual—the potential leader.

The foregoing should not mislead those who feel that they can find a sinecure in engineering without proper qualification and thorough training. The fact that most or even all graduates are currently finding "jobs" is no assurance of the more distant future. More important is the contribution one makes to the profession and toward society. It is well known that Cornell is quite selective as far as academic standing of applicants for admission is concerned. It is hoped that sufficient consideration is also given to basic aptitudes. Such things were unknown when this individual applied for admission to Cornell in 1909. Had there been, he and perhaps some of his classmates would have been diverted to other fields of endeavor for the mutual benefit of all.

Getting down to the reading matter in the October issue, one comment might be appropriate on the excellent article on Alchemy to further emphasize the revolution in science and technology. The article points out that Alchemy was the forerunner of modern chemistry. To this thesis may be added the fact that modern chemistry has in turn reached the goal of the ancient and medieval alchemists. The transmutation of elements, be they radioactive, has been accomplished and this in principle was the objective of the alchemists.

A revealing item under "College News" referring to the new program of tutoring indicates that those who need such help most do not take advantage of the opportunity. This might have been expected but it again emphasizes the importance of proper selection and high standards. Let those who are unwilling to assume their responsibilities more faithfully be released, perhaps to attend one of the mass-production, low standard schools. There he may be able to muddle through four years with minimum effort and then possibly find a job. Unfortunately such engineers add nothing to their profession and very little to society. This is the type that has given the profession a reputation for narrowness of intellectual vision. It is also the type that probably never learns to properly express ideas either orally or in the written word. The modern world demands much more of its engineers.

A gratifying item in the same department is the story of the tremendous amount of research being pursued at Cornell. Unfortunately, and this is characteristic of American research in general, not enough of this is fundamental or basic. In addition not enough of it is for the humanities. This has the tendency of increasing the lag between the social and the physical sciences. It is this gap which has been blamed by many for the critical conditions prevailing in the world today.

It must be a rare privilege to have an instructor with the wit and intellectual integrity of Director Erickson. His article may be interpretated as developing a fundamental proposition, namely that there should be no room at Cornell for anyone not seriously committed to work hard and diligently. This is far more important than mere size of enrollment. Far better one well trained engineer with sound intellectual habits than a dozen mediocre ones. President Malott along with others has pointed out the lesson that can be learned from Russia in this respect. Whatever else may be said, Russia demands hard, serious, thorough application from its scientific and engineering students. All of this does not at all preclude outside activities and interests which should indeed be an integral part of one's education.

Some concluding thoughts on Dean Hollister's advice to freshmen. Cornell can never adequately reward the Dean for his services to the university. The dream engineering campus is a heroic monument to his endeavor. More important are the high standards which have been established through his efforts, particularly the five year plan. This is a definite step in line with the social and humanitarian conditions of this critical period. Science and technology have opened up new vistas of power which can be used for the destruction or improvement of man. Engineers have a moral responsibility to see that

(Continued on Page 54)

Francis Thompson joined Westinghouse in 1952– has since earned M.S. degree and 10 U.S. patents

At 28, Francis T. Thompson, a 1952 B.E.E. graduate of Rensselaer Polytechnical Institute, is an engineer on his way to a distinguished career *in a hurry!*

Upon completion of the Westinghouse Student Training Course, he was immediately selected to attend the Advanced Design Course at the University of Pittsburgh. Upon completion of this course, he was assigned to the Research Laboratories where he worked on color TV and high definition TV projects. Since August, 1957, he has been assigned to the New Products Dept. where he has developed a transistorized control system combining both digital and analogue equipment to regulate steam turbines in paper plant applications.

Most important, *Francis Thompson is doing exactly what he wants to be doing.* He earned his MS degree through the Westinghouse Graduate Study Program in 1955 and is now working toward his Ph.D. Active in the IRE, he has submitted 45 patent disclosures (which have already resulted in awards totaling more than $1,000.00); and he has 10 U.S. patents pending.

Francis Thompson is one of many talented young engineers who are finding rewarding careers with Westinghouse. You can, too, if you've got ambition and you're a man of exceptional ability. Our broad product line and decentralized operations provide a diversity of challenging opportunities for talented engineers. Guided missile controls, atomic power, automation, radar, semiconductors, and large power equipment are only a few of the fascinating career fields to be found at Westinghouse.

Why not find out now about the opportunities for *you* at Westinghouse? Write to Mr. L. H. Noggle, Westinghouse Educational Center, Ardmore & Brinton Roads, Pittsburgh 21, Pennsylvania.

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Other ITT "space men" are making important contributions to air reconnaissance, inertial navigation, infrared, missile guidance and control, electronic countermeasures, radio communications, radar, scatter communications, and other categories vital to national defense.

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Founded in 1885

THE CORNELL engineer

DECEMBER 1958 VOLUME 24 NO. 3

The Rise of Balloons 15
by Marie Gast

Electronic Chauffeurs 18
by Richard A. Wolf, EP '62

Cosmic Rays: Nature's Barrier to Manned Space Flights 20
by Robert P. Larsen, M.I.E. '59

Confessions of a Director or Twenty Years Behind the Desk 24
by Dr. Fred H. Rhodes

Letters to the Editor 6

Fifty Years Ago in the Engineer 30

President's Message 32

Alumni Engineers 33

College News 36

Research at Cornell: Surfaces Studied by Electron Microscopy . . . 38

Technibriefs 42

Faculty Profile: Professor Bart J. Conta 48
by David S. Kessler, ME '62

Stress and Strain 56

Cover: The First Balloon Voyage–1783

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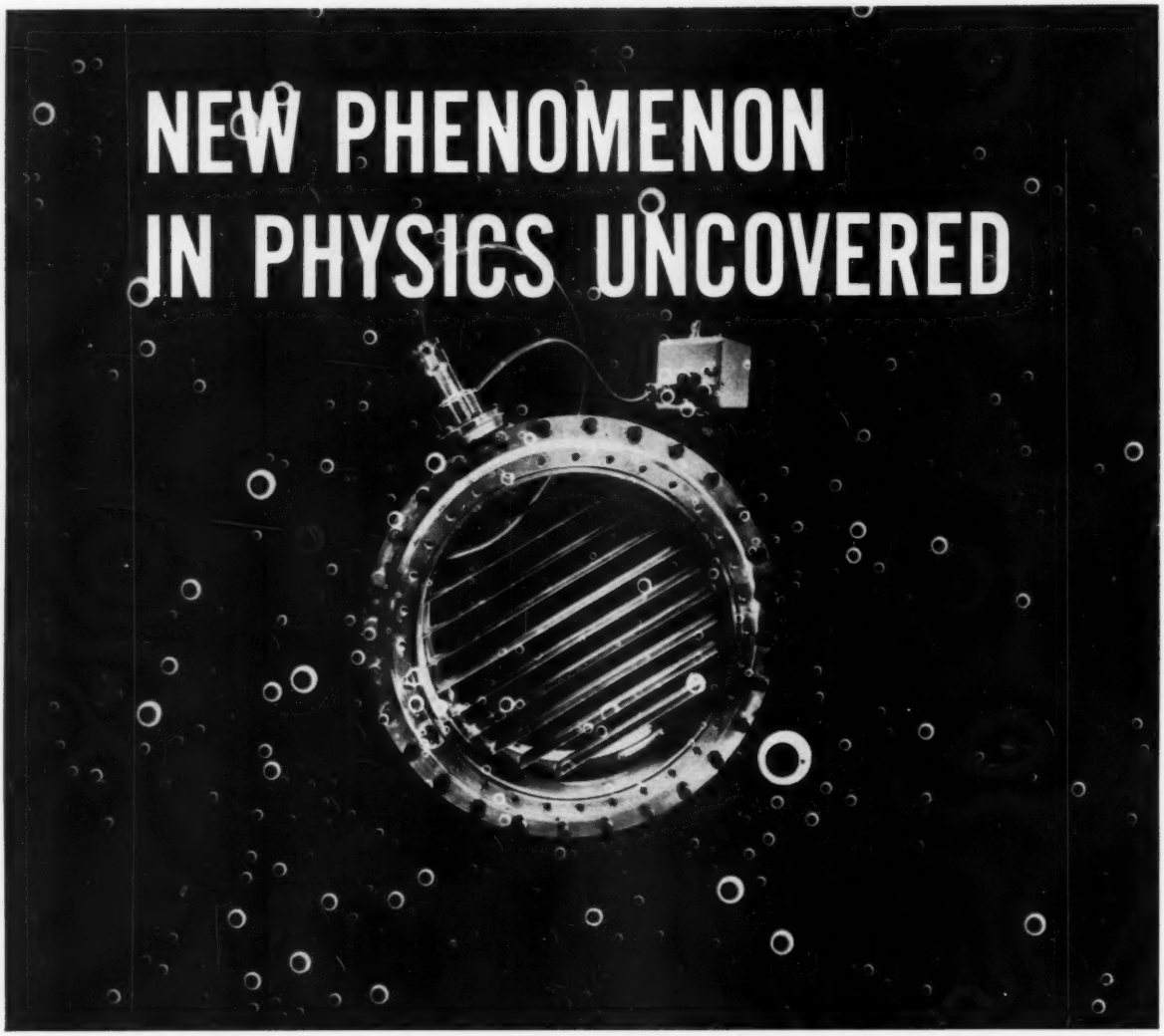
NEW PHENOMENON IN PHYSICS UNCOVERED



Investigation in detecting cavitation, or forming of vapor bubbles in liquid flow, led AiResearch engineers to the discovery of an important new phenomenon . . . *that flow of bubbles in liquids generates a magnetic field.* This discovery, among other things, helps solve critical flow problems in missile and industrial fields. The AiResearch cavitation detector pictured picks up these tell-tale signals as the liquid passes through the grid, pinpointing the cause of trouble.

Many such pioneering developments are underway in challenging, important work at AiResearch in missile, electronic, nuclear, aircraft and industrial fields.

Specific opportunities exist in system electronics and servo control units; computers and flight instruments; missile auxiliary power units; gas turbine engines, turbine and air motors; cryogenic and nuclear systems; pneumatic valves; industrial turbochargers; air conditioning and pressurization; and heat transfer, including electronic cooling.

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***Arthur Herman** graduated from Johns Hopkins in 1955 and went to work immediately in the Metal Products Division of Koppers as a Design Engineer.

In December of the same year, he was promoted to Supervising Engineer of the Design Section, where he found that Koppers offers truly challenging problems in design engineering.

Then, in September 1957, Art was transferred to the Coupling Sales Department as a Coupling Application Engineer. He is serving in that capacity now.

An employment record alone is seldom descriptive of the opportunities and responsibilities many positions represent. For instance, Art was recently designated as Division Representative to investigate the potentialities of a new product developed by a European manufacturer. This assignment took him abroad.

Art is particularly articulate about his job and the constant challenge it presents for him as an individual.

"When I first started as a design engineer," he said, "I didn't realize the scope of activities in which I'd be called on to participate. Sure, I had good theory and background for design engineering, but I had little concept of the problems of production, and even less familiarity with the techniques of sales or marketing. My work as an application engineer gets me into almost every phase of the business — development, production, marketing, finance, and so forth.

"At Koppers I feel that I receive the necessary guidance to enable me to contribute fully to the Company's activities. I am encouraged to make decisions. If these decisions involve factors with which I am not entirely familiar, I can rely on the judgment and experience of others working with me. At all times, I feel that I have real access to upper levels of management where my ideas have always been received thoughtfully and given full consideration. Now, I feel confident that I am doing a job for Koppers, and, what is equally important, that my associates and supervisors understand and appreciate it, too! I have found that through such methods as the Management Appraisal Program, Koppers makes every effort to recognize and reward good performance."

A lot of things could be said about Art Herman, and the career he found at Koppers. But as the manager to whom Art reports commented recently: "Art's an able man . . . we're glad to have him. He is making a real contribution to the Company. All we in management can do is try our best to develop a man's best qualities and, when he proves to have the versatility that Art has, to see that this versatility is recognized."

If you feel that this is the atmosphere in which you would most like to build your profession and mark your progress, write to the Manager of Manpower Planning, Koppers Company, Inc., Pittsburgh 19, Pennsylvania or contact your College Placement Director.

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STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

I've been asked whether non-aeronautical engineers have good prospects for advancement in the aviation industry.

The answer is *yes, definitely!* At Douglas many of our top supervisory people have moved up from other engineering specialties. The complexity of modern aircraft and missiles requires the greatest variety of engineering skills known to industry.

For example, we now have pressing needs for mechanical, structural, electrical and electronics engineers in addition to aerodynamicists, physicists and mathematicians. Whatever your background in the engineering profession may be, there are prime opportunities in the stimulating aircraft and missiles field.

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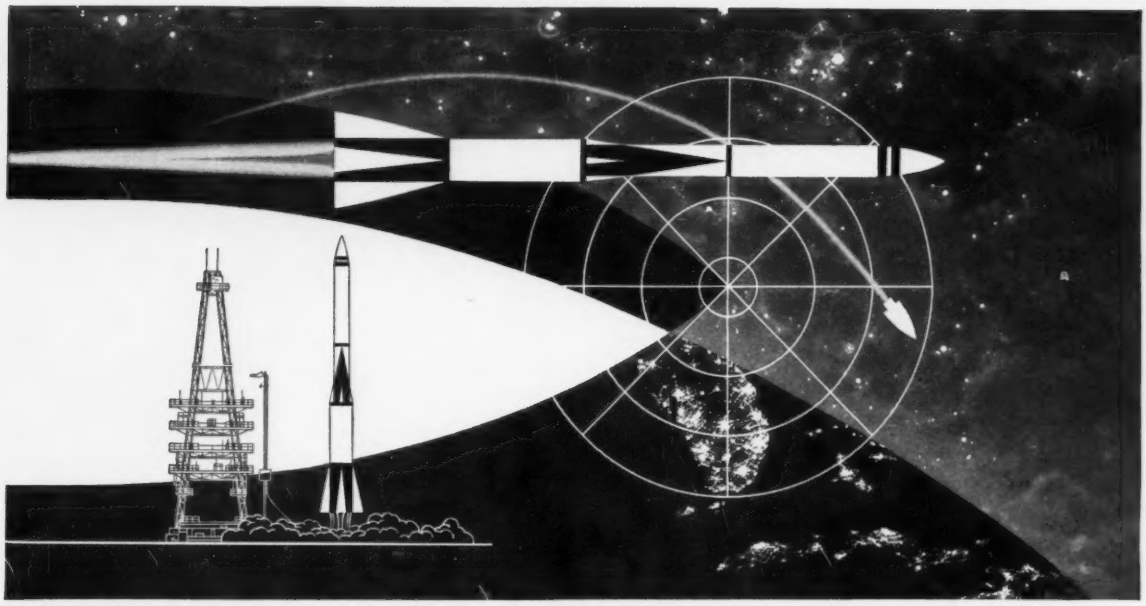


• An artist's conception of the launching of the missile, its guided flight, its track on a radarscope in its final stage.

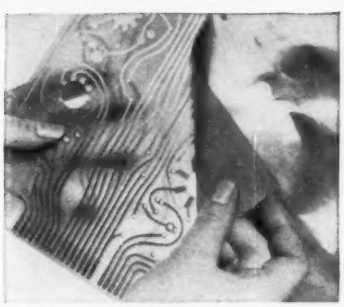
MINIATURIZATION for the MISSILE AGE

Another new design frontier for copper

"The increasing amount of equipment carried on military aircraft . . . has made it necessary for the design engineer to cram more equipment into less space."

"To achieve maximum usefulness from miniaturization, all elements of the system must be reduced to the same order of size. New design techniques, components and production methods have been developed to aid the designer in reaching this goal."
– *Electronics* Magazine

Many of these new design techniques are taking advantage of the properties of a very old material – copper. One of copper's big jobs is conducting electricity in control circuits. Of course, copper is the best commercial conductor, but when miniaturization takes over, many other properties of copper also become important.



Printed circuit of copper bonded to epoxy glass base, and sheet of the adhesive-backed copper used in its manufacture by Rubber & Asbestos Corp.

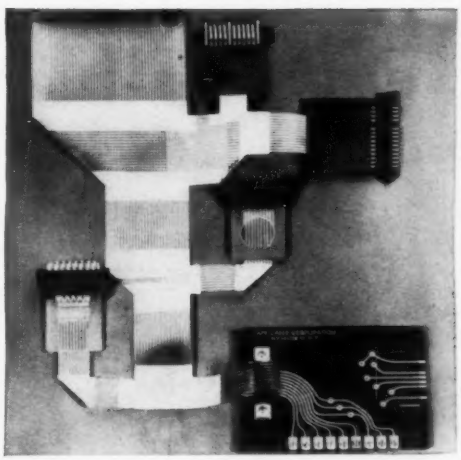
In the printed circuits that are the very basis of most subminiature designs, the conductors may start out as a sheet of copper foil. This foil often has to be very thin – yet free of flaws that might cause circuit discontinuities. Here, copper's ductility is vital.

Good joining properties are also important. Some of the tiny connections are resistance welded. (Copper can withstand the temperatures.) Others are soldered. (Easily done with copper and with very little solder metal.)

Complex control circuits can now be wired with flexible Tape Cable. This tape may contain as many as 50 copper conductors, side by side – and weigh only 2½ pounds per 100-ft. roll. The standard size of each of the rectangular conductors in the tape is 0.0015 in. by 0.03 in.

Obviously, with such small cross sections, no deterioration of the conductor is permissible. Yet temperatures, particularly in missile applications, are high. The answer is found in copper which is free of oxygen–eliminating oxidation, scale formation and conductivity losses.

In other high temperature applications, copper's high thermal conductivity can be used to protect more delicate parts from excessive heat. For this reason it is useful in missile nose cones. And, of course, copper's excellent corrosion resistance is often valuable in exposed parts and in tubing.



Wiring harness of Tape Cable provides flexible, flat 50-conductor interconnection system.

The field of missiles and rocketry is but another example of a design frontier where the versatility of copper and the copper alloys helps make progress possible.

If you'd like to know more about these metals and their design possibilities, send for "A Guide to Copper and its Alloys." Write The Copper & Brass Research Association, 420 Lexington Avenue, New York 17, New York.

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On Display at Carpenter Hall . . .

THE RISE OF BALLOONS

by Marie Gast

This month a colorful and informative exhibit on the development of lighter-than-air craft highlights the University's engineering library at Carpenter Hall. The exhibit illustrates the evolution of lighter-than-air craft from the first flight of a blue and gold silk bag filled with heated air to the modern giant helium-inflated plastic bubbles which carry scientific equipment into the stratosphere. The prints, engravings and photographs have been selected, not only for their historical or scientific significance, but also because of their immediate appeal to the eye and to the imagination.

Outstanding items include beautifully executed colored engravings made in Germany of early ascensions which have been assembled into a collection recently published by the Ariel Press of London. Here too are books published in France at the very time when ballooning had become the sport of the century. To bring the display up to date, there is a review of the great airships of the thirties and a fine collection of photographs of the modern polyethylene balloons used to probe the stratosphere.

Balloon Designed in 17th Century

Since before the time of Leonardo da Vinci man has been trying to fly. By strapping on wings or by gluing on feathers, he had without success tried to imitate the flight of birds. But not until the latter part of the Age of Reason did he sail off into the atmosphere in a decorative, imaginative and surprisingly simple new vehicle, the balloon.

It was the seventeenth century

ABOUT THE AUTHOR

Marie Gast, as librarian at Carpenter Hall, is no stranger to Cornellians who frequent the Engineering Library. Born in Cleveland, Ohio she received her B.A. at St. Olaf College in Minnesota and her M.A. at Western Reserve. She has been with the library for six years and has been responsible for the presentation of many fine exhibits. Her present exhibit on the History of Balloons can be seen at the library during the month of December.

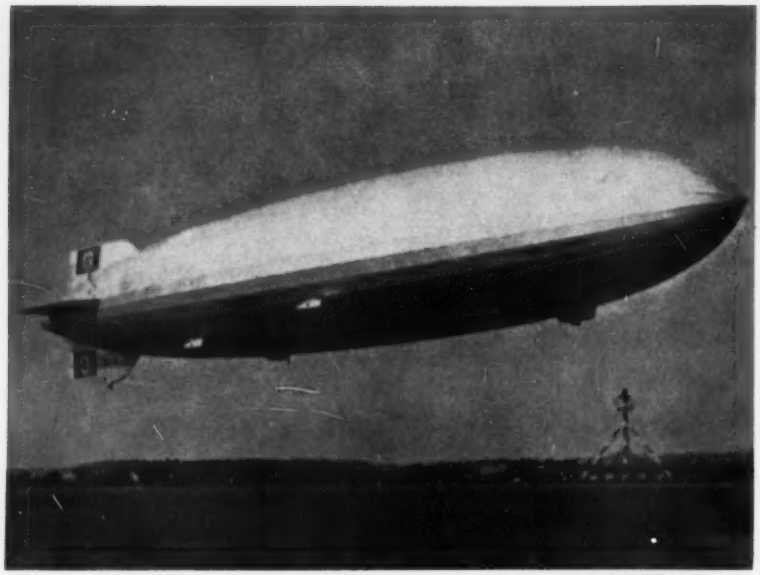
Kenneth Workman

The author is explaining part of the balloon exhibit now set up in Carpenter Hall.

←

This shows the means by which the "bubble" of the balloon is restrained at the launching site. The bubble of gas displaces enough air so that the entire balloon system is "light" and will ascend. As the system ascends, the bubble will gradually fill out the entire polyethylene envelope.

General Mills



Luftschiffbau-Zeppelin

Probably the most famous airship of them all is *The Graf Zeppelin*. In 1928, under the command of Dr. Hugo Eckener, this airship won wide acclaim by flying around the world. The journey took twenty-one days.

Jesuit, Francesco de Lana, who first inferred that a vessel containing 'no air' would weigh less than one filled with 'some air'. Accordingly, he designed an airship of four hollow globes, each twenty feet in diameter, to be made of copper so thin that when depleted of air, they would weigh less than the atmosphere. The globes were to support a light boat for the passenger. Though da Lana realized that considerable atmospheric pressure would be exerted on the globes, he failed to realize that it would have amounted to a force of several million pounds, capable of crushing the globes. The sole reason he made no attempt to construct such a vessel was his belief that navigation of the air would be contrary to the laws of God and man.

Then in 1783, one hundred and twenty years before the Wright brothers made their powered flight at Kitty Hawk, two other brothers, the Montgolfiers of Annonay, France, proved the feasibility of balloons. Joseph and Etienne Montgolfier were papermakers by trade who, after watching paper bags filled with smoke rise over their kitchen fire, came to Paris to construct full scale balloons.

On September 19, 1783, the royal court assembled at Versailles to witness the flight of a *Montgolfière*, or hot-air balloon. Its passengers caged in a wicker basket were a sheep, a cock, and a duck. The machine rose more than a quarter of a mile into the air and sailed for two miles before landing. The riders alighted safely save for the cock, which had been kicked by the sheep and suffered an injured wing. (It later became a sport to carry up dogs and cats and watch them descend on parachutes. One aeronaut even ascended mounted on the back of a white stag).

Soon afterwards the first human ascent was made, the airmen being the physician Pilatre de Rozier and the Marquis d'Arlandes. The craft, a silk bag lined with paper and gaily decorated with the signs of the zodiac, was provided with a wicker gallery attached by cords. To inflate, the bag was suspended between two masts, and a fire was lighted beneath a hole in the gallery. A brazier was slung aboard just as the balloon began to rise so that heat was maintained during the voyage. The pilots could stoke or damp the fire as necessary for lift. Strangely enough, records show that the Montgolfiers believed the balloons rose by virtue of a gas created in the smoke from the fire of chopped straw and wool, rather than because of the rarification of the heated air.

Hydrogen Balloon Soon Developed

The development of the hydrogen balloon or *Charlière* was proceeding at the same time. Earlier experiments by Cavendish had indicated that hydrogen is only one-fourteenth the weight of air, and thus a superior lifting agent to heated air which is only one-half the weight of cold air. At five o'clock in the evening of August 27th, 1783, at the firing of a cannon, the first unmanned hydrogen balloon rose from the Place des Victoires in Paris. It descended in a small village some fifteen miles away, where, according to reports, it terrified the peasants. Hatton Turner in his history of ballooning, *Astra Castra*, relates that the stench of escaping hydrogen held the villagers at bay until one bold one fired a musket at the bag. Thereupon the others attacked it with flails and pitchforks, tied it to a horse's tail, and let it be dragged across the country.

When the physicist J. A. C. Charles ascended in November of that same year, the equipment he carried included a barometer and a thermometer by which he measured the decrease in atmospheric pressure and temperature. There was also provision for taking ballast and a valve at the top of the bag to release excess hydrogen as the atmosphere thinned and the hydrogen expanded. Even though hydrogen was known to be highly inflammable, it soon replaced heated air as the lifting agent, because of its superior lifting power. The basic concept of those early hydrogen balloons remains the same as those used by modern science.

One of the most notable of those early voyages was the crossing of the English Channel in January, 1785, by the French pilot, Jean Pierre Blanchard and an American, Dr. John Jeffries. Jeffries, who paid for the venture, had promised Blanchard that he would ascend with him in the balloon only if it was safe to do so. The voyage began under strained personal relations, for Jeffries discovered that Blanchard had concealed a heavy lead

belt beneath his clothing, hoping to convince Jeffries that the *Charlière* could lift only one passenger.

Their balloon was rigged with silken wings and a useless rudder. They carried with them scientific apparatus, pamphlets to fling to the crowd, food, and extra clothing. As they swung over the Channel, they began to descend too rapidly, and soon they were pitching biscuits, apples, and brandy into the sea. When there was no more ballast, and the sails and oars had been jettisoned, they began to cast away their clothing. Blanchard in distress even shed his trousers, but he clung to a packet of letters which he mailed over the side as they reached the French shore. After a three-hour flight, the airmen were deposited amid the treetops near Calais, from whence they were borne away in triumph by the citizens. A monument still stands in the grove commemorating the spot of descent.

Balloons Had To Be Controlled

Because there was no way to steer, these early balloons, however attractive, were not practical vehicles, though their application to scientific research was quite apparent. During the next century showmen and sportsmen in both Europe and America benefited from them, military observers in the American Civil War and in France watched battles from them, and for a brief period a mail and passenger service in France utilized them.

At virtually the same time that the spherical balloons were being sent aloft, a French officer, Jean Baptiste Meusnier, was composing a series of drawings of an ellipsoidal balloon. He noted the need of an elongated shape, with a definite bow and stern as on a ship, in order to make a navigable vehicle or 'dirigible.' Ballonets were to be placed within the outer envelope of the airship to preserve the shape, which was otherwise altered by the natural loss of gas. He also suggested the use of the airscrew. Because of his untimely death in the French Revolution, his plans were never carried out.

Before long, inventors in Italy, Germany, France, and America were submitting plans for pressure vehicles. Finally in Paris in 1852 Henri Gifford, inventor of the steam injector, achieved directed flight. His machine was 143 feet long and symetrically elongated with pointed ends. It was propelled by a three horsepower steam engine with an eleven-foot propeller. It reached a speed of 5.3 miles per hour. Subsequently, others produced plans utilizing electricity and the internal combustion engine.

The earliest airship was a simple cigar-shaped balloon with a passenger car slung far beneath it. As the weight of the car tended to distort the shape of the bag, a semi-rigid construction was introduced. In this system a keel of girder construction was extended the length of the envelope. The keel was sometimes suspended below, but more often it formed an integral part of the envelope.

By the advent of World War I the designs had become fairly standardized with emphasis placed on the military airship. It must be remembered that in 1914 the airplane had not yet been highly developed as a military vehicle. The most effective non-rigid military airship was and still is, the "blimp," now produced in the United States under the auspices of the Navy Department. This relatively small vessel, constructed of a streamlined, gas-tight rubberized envelope is used mainly for observation and training. The newest ones for coastal patrol are equipped with radar.

Zeppelin Builds Rigid Airship

Count Ferdinand von Zeppelin perfected the most spectacular dirigibles of rigid construction. Zeppelin, a German Army officer, had been greatly impressed with the use of free balloons during the Civil War. He had come to this country in 1863 to volunteer as an officer in the Union Army and had made his first ascension from Minneapolis that year. When he retired from the German Army, he began planning his remarkable rigid airships. The ships had a rigid, metal structural framework covered with a metalized fabric. The passenger car, controls, and power plants beneath the ship were all integral parts of the framework. A number of gas-filled cells were suspended within the framework to give it lift. By 1914, fourteen years after Zeppelin's first successful flight, twenty-five of these airships had been built, many of them devoted to passenger and cargo service. Germany had taken the lead in their production.

With the outbreak of war, they were commandeered by the German Army. Production continued and at its height, one ship was being produced every six weeks. Ma-

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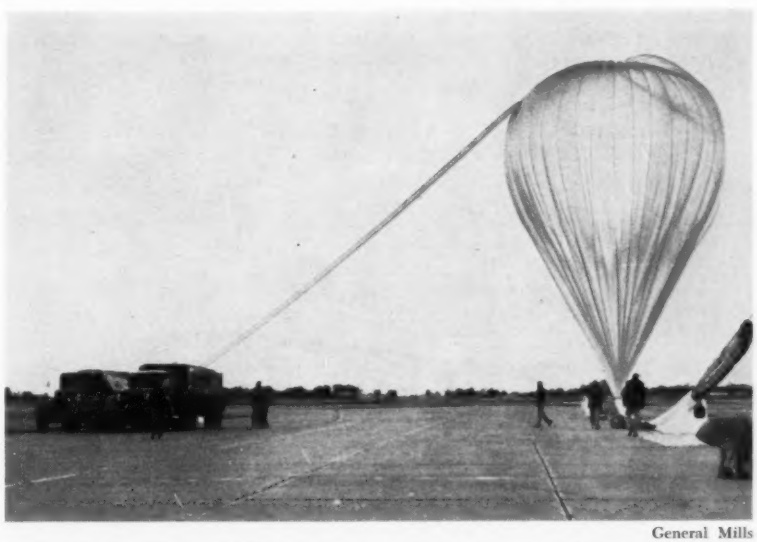

General Mills

In the fall of 1957, several hundred photographs of the sun's surface were taken by a specially-constructed telescope-camera system, mounted on this launching vehicle. The trucks to the left of the balloon carry high-pressure helium, which is forced into the balloon bubble via the 18" polyethylene tube. A large parachute was used to lower the telescope-camera system and is the connecting link between the balloon base and the top of the gondola in the picture.

ELECTRONIC CHAUFFEURS

by Richard A. Wolf, EP '62

Since the invention of the auto, driver effort has been steadily reduced with many innovations of automatic devices. Recently, engineers from highway departments, the electronics industry, and the automobile industry have made important advances toward the ultimate goal in this auto evolution—complete automatic control of highway vehicles. These advances utilize many types of electronic equipment to increase driver safety and decrease traffic congestion.

In early automobiles it was necessary for the driver to manipulate the gearshift, clutch, spark advance, hand throttle, and choke to help the engine run efficiently in a certain speed range. In performing all of these operations, however, the driver was, in effect, reacting to situations which could be sensed from within the car. He knew to open the choke, for example, when the engine was cold.

In fifty years of engineering progress, the automobile manufacturers have developed systems which react to conditions inside the car (e.g. engine speed, throttle opening, temperature) by performing mechanical operations such as shifting gears and operating the choke. This development has progressed to the point where the driver is responsible for almost no operations designed to help engine performance, except those of adding gas and oil. Driving has come to consist simply of determining the speed and direction of the car.

Therefore, the next major step in the development of automatic controls will have to be a device which will take over another driver function by reacting to a condition outside the car. With power steering and power brakes, the driver does not have to provide any appreciable mechanical energy to control the car. He merely acts to stimulate a hydraulic device, or the engine itself, to change the velocity of the vehicle. If an electronic system could be devised to sense the situation around the car and conclude that the car's speed or path must be changed, the electronic system could simply stimulate the power controls to accelerate, decelerate, or turn the car.

Human Driver Can Be Replaced

In today's traffic situations there is a definite need for a device to re-

RCA

A system operated by detector loops measures the speed of each vehicle on a stretch of this test road near Princeton, New Jersey. If the driver is exceeding the speed limit, a sign automatically flashes him a polite warning.

place the human driver. The ability of a human being to control a vehicle is severely limited by imperfect eyesight and hearing and limited muscular speed, strength, and control. However, with all his faults, the average driver makes a fatal mistake only once in many thousands of vehicle miles. It is extremely difficult to design any machinery with such reliability. Therefore, the automotive industry will make the step from complete driver control to complete automatic control very slowly, progressing from simple to more complex mechanisms as reliability is increased. Each new device will have to be more dependable than the average human driver in the function it is intended to serve.

Inadequate vision is definitely one of the human driver's most serious defects. At high speed it is imperative that the driver know the position and condition of the road for a considerable distance from the car. But his actual optical view of these conditions may be limited by darkness, headlight glare from approaching vehicles, curves, hills, trees, blind spots in the car, and inadequate rear view mirrors.

One method for warning the driver of cars around him has been developed by Ford Motor Company. The velocity of a vehicle's headlights approaching an equipped car from behind is measured by a photoelectric cell and computer. If the vehicle is approaching at an unsafe speed, the taillights of the equipped car light up to warn the approaching driver, and a light or buzzer operated inside the equipped car warns the driver of the other vehicle's approach.

Another system to help the driver keep his speed in line with the surrounding traffic is the radar brake. A car equipped with this device has a radar set in the front end which operates the power brakes automatically if an obstacle is sensed ahead. However, many difficult problems arise when the brake must be adapted to stop the car for obstacles that are around turns and over hills. In low speed city traffic the device would be completely useless. In high-speed heavy traffic it could cope with some situations but not with others. Many experts feel it would be better to have all of the braking done by the driver rather than to require the driver to make the decision of which system should be used to stop the car, since a misjudgment in this matter could be fatal.

Research Develops Outside Controls

Both of these devices are completely included in the car. Considerable research is being done by the Radio Corporation of America and the Nebraska Department of Roads on a system for traffic control which has components outside the car. The first requirement of such a system would be that something in or around the highway be capable of sensing the location of every automobile near it. The second requirement of such a system would be that it somehow communicate this information to the driver of each vehicle as it concerns the operation of his car, or that the system provide signals for a device within the car which would operate the brakes or accelerator automatically.

The system now under development employs a series of loops of wire imbedded in the highway. Detectors in the loops of wire are sensitive to any change in the inductance of the circuit, such as would occur if a car were to run over the loops. The detection systems themselves require no equipment in the automobiles, and combined with simple devices could have many uses. For instance, using the detector units in conjunction with computors, traffic signals at intersections could be regulated by the amount of traffic on each road. By using signal lights, merging traffic could be coordinated. Also, lights operated by these detector units could signal approaching drivers of the presence of an obstacle in one lane.

In the RCA laboratory grounds, there is a road with these detector loops buried in it. The signals from the loops are sent to a computer which determines the speed of the car. If the driver is exceeding the posted speed limit, a sign flashes a warning to him. Various mechanical and electronic devices are now in use to determine speed, but a

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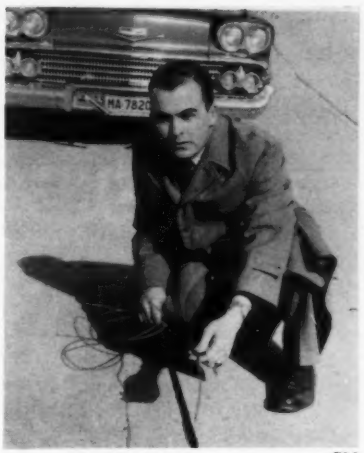
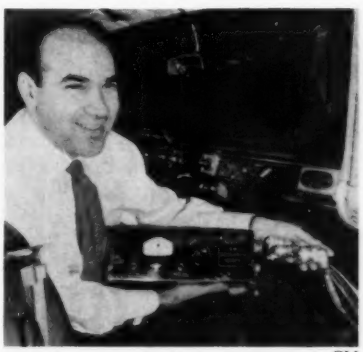


GM

The major components of the General Motors electronic steering system are shown here and below. This wire, embedded in the pavement, produces a magnetic path for the guidance system.

GM

Two coils on the front bumper straddle the magnetic path. Voltage variations feed into the electronic computer held by the GM staff member (below).



GM

This computer, the "brains" of the system, fits into the automobile's glove compartment.

COSMIC RAYS:

NATURE'S BARRIER TO MANNED SPACE FLIGHT

by Robert P. Larsen, M.I.E. '59

A cosmic radiation belt, containing extremely intensive components, is prophesied as encircling the earth. Cosmic radiation intensities of 10 roentgens/hour have been metered by Explorer Epsilon at an altitude of 2000 km. over South America. If manned space trips are envisioned, effective cosmic countermeasures must be developed to reduce this cosmic irradiation to a tolerable human level (5 roentgens/year). Thus paramount attention has been devoted to secondary and primary cosmic radiation aspects, because it represents a potential hazard to humans and space vehicle instrumentation.

Consideration has also been devoted to micrometeorites, aurorae and galactic radio emission. Micrometeorites represent a potential hazard to space vehicle envelopes through a ballistic erosion process. The latter two electromagnetic phenomena potentially pose disruption hazards to space vehicle communication systems.

Secondary Cosmic Radiation

This phase of cosmical physics has been authentically formalized, because inherent attributes fostered its development prior to the International Geophysical Year. Metering vehicles (rockets) and experimental particle simulation techniques have enabled scientists to establish hypotheses and theories describing these underlying physical phenomena.

High energy primary radiation entering the atmosphere interacts with the atmosphere's molecular structure producing secondary cosmic radiation. These secondary rays may be created by three varieties of related processes: nuclear events, electrodynamic events, and spontaneous decay events. Pictorially these phenomena may cascade to form secondary cosmic radiation similar to figure one.

Secondary cosmic rays, produced through nuclear events, represent the nuclear explosion phenomenon that occurs when penetrating primaries or highly energetic secondaries collide with atmospheric nuclei producing disintegration fragments. These nuclear explosions, commonly termed "stars," characteristically emanate from an impact center with resultant disintegration fragments departing in semi-random directions. These emitted disintegration fragments represent a variety of L-mesons and nucleons. Logically, star input energy and momentum must be distributed to the newly created fragments in obeyance with conservation of energy and momentum.

Electrodynamic events generally encompass the electronic component of secondary cosmic radiation created by interactions among negatrons (electron), positrons (positive electron) and photons with atmospheric molecular elements. Two energy transformation processes are normally involved, either radiation loss (Bremsstrahlung) or its inverse, pair production.

In essence, Bremsstrahlung theory states that a charged particle experiencing a change in acceleration radiates energy in electromagnetic form. If primaries are composed of electronic constituents, a positron passing near an atomic nucleus would create a deflective force; conversely, a negatron passing near an atomic nucleus would create an attractive force. These forces cause particle path bending which is dynamically synonymous to particle acceleration resulting in electromagnetic radiation obeyance with Bremsstrahlung theory.

This electromagnetic radiation represents the energy loss experienced by the incident particle, generally termed radiation loss. This radiation loss gains significance as: (1) absorber atomic number is increased (2) incident particle energy is increased or (3) incident particle mass is decreased.

Pair production is the process of creating a positron and negatron following collision of an atomic nucleus with an incident photon which simultaneously vanishes. Accordingly, the photon interacts with a negative energy state electron in the vicinity of the nucleus of the gas molecule which recoils to a positive final energy state. A strong field of force, such as associated with a nucleus, is a prerequisite for pair production to fulfill requirements of energy and momentum conservation. Since primary cosmic radiation is either electrons and/or protons, this pair production process occurs as a supplementary event to the initiating radiation loss process.

Electronic showers are finite cascaded manifestations of the above discussed electrodynamic events. As the cascading process underlying an electronic shower develops, the respective energy levels of subsequent components (positrons, negatrons, and photons) must decrease, since instantaneous composite energies must always be equivalent to the initiating particle energy. These cascaded electrodynamic events will continue random propagation until consecutively created electronic components dissipate their energy by molecular collision, while by-product photon energies are dissipated through photoelectric and Compton phenomena.

The third category of producing secondary cosmic rays is the process of spontaneous decay. These events are almost exclusively associated with mesons which are created through nuclear events as discussed above. Macroscopically, mesons are unstable, charged, or neutral, particles characterized with intermediate mass between that of an electron and proton.

The pi-mu meson decay process seems to be the most prevalent. This spontaneous decay process originates with creation of the pi meson varieties following a nuclear event. Their finite lifetimes limit their relativistic travel. Upon completion of their respective lifetimes, pi mesons experience spontaneous decay.

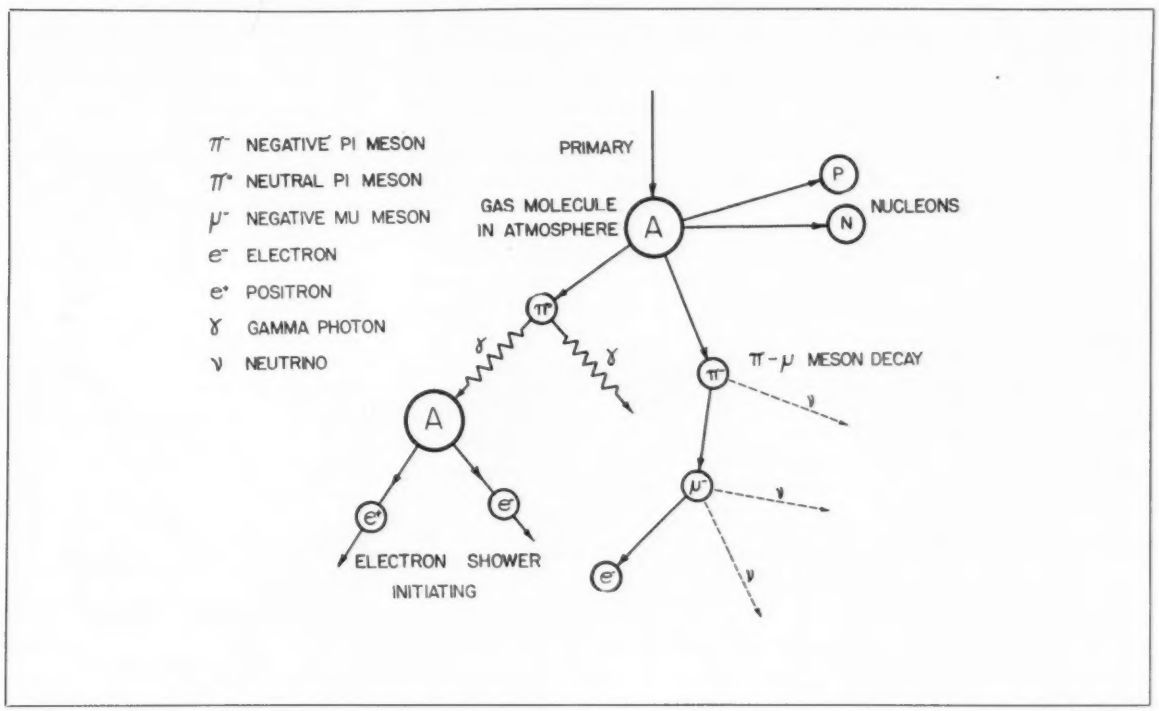
After the charged mu mesons have traveled their equivalent lifetime distance, they similarly undergo spontaneous decay.

A few pertinent observational facts concerning pi-mu meson components in secondary cosmic radiation have been established. First, mu mesons traverse considerably longer paths than charged pi mesons because lifetime relationships differ by a magnitude of 100. Secondly, pi mesons are seldom metered as a secondary cosmic component at low altitudes (sea level vicinity). This significantly implies that mu mesons are the major cosmic component in the lower atmospheric strata. This is quite compatible with the logical sequence of spontaneous decay events as presented above.

It should appear quite evident that the several phenomena influencing secondary cosmic radiation represents an extremely complex relationship to quantify. As the cosmic primaries impinge on the free atoms existing in the upper atmosphere, several phenomena are simultaneously influencing cosmic radiation characteristics. As these heterogeneous rays traverse toward the earth, energy transformations (collisions) reduce succeeding particles' penetrating power. The less energetic particles are continuously being screened out, correspondingly reducing the radiation intensity level. Hence, only the highly energetic primaries and secondaries have sufficient penetrating power to continue their downward movement. But even these particles are continuously experiencing collision losses which gradually reduce their speed and associated penetrating power.

The above non-quantitative comments concerning secondary cosmic radiation phenomena have been designed to serve as a theoretical summary. By developing a comprehensive appreciation for the related theoretical aspects associated with cosmic secondaries, the formulation of hypotheses with regard to primary cosmic radiation may be enhanced.

Secondary cosmic radiation may generally be qualitatively por-



Ted Loane

Figure 1. A typical secondary cosmic radiation production sequence.

trayed as shown in figure two. Experimental investigations have established that secondary cosmic intensity is parametrically dependent upon geomagnetic latitude and longitude in conjunction with altitude. This means that secondary cosmic intensity increases with higher geomagnetic latitudes, displaying respectable symmetry about the earth's magnetic equator. Also, the measured east-west longitudinal effect indicates that incident secondaries from the westerly direction slightly exceed those incident from the east.

The exponential peaking or "maxima" intensity effect experienced within the 10-20 km altitude range is the integrated manifestation of the previously discussed cosmic phenomena of electrodynamic and spontaneous decay events. These secondary cosmic rays are created through interaction of incident primaries with the atmospheric molecules and subsequent cascading events in accordance with these phenomena. The pronounced intensity decay effect experienced at low altitudes portrays the absorbing influence of the lower atmosphere in screening out the less energetic secondaries.

Primary Cosmic Radiation

With the advent of the International Geophysical Year and realistic application of an earth satellite as a scientific monitoring instrument, tremendous advances have recently been unveiled in this dynamic phase of cosmic ray technology. Explorer Epsilon was instrumented specifically to monitor cosmic radiation characteristics in outer space. Its telemetered cosmic measurements have stimulated new concepts which have nullified previous hypotheses concerning primary cosmic radiation.

The telemetered cosmic data received from Explorer Epsilon suggests that primary cosmic quality and quantity obey a complex relationship with altitude and geomagnetic latitude. Mathematical quantification of primary cosmic intensity-spatial relationships remains in the preliminary development stage; however, considerable empirical data recently metered permits establishment of parametric plot relationships. This measured intensity relationship can be generally represented as shown in figure three.

Empirically, intensity doubles every 100 km, commencing at 400 km and continuing up to 2000 km which is the upper limit of metered data currently available. This exponental intensity relationship is expected to continue in a similar manner to about 9,600 km where maximum cosmic primary intensity is anticipated. It is expected to decay past this altitude with disappearance in the vicinity of 64,000 km. This hypothetically formulates a radiation belt commencing at 400 km, peaking at approximately 9600 km and disappearing at 64,000 km.

Primary cosmic radiation has been experimentally identified as composed of electrons and/or protons. Metered mean cosmic flux at 1500 km implies a magnitude of 1000 particles/cm^2-sec-sterad whose range exceeds 2 gram/cm^2. Therefore, if cosmic primaries are electrons their energy levels must exceed 6 Mev; while if protons, their energy levels must exceed 40 Mev. This establishes an empirical approximation toward defining the complex primary cosmic energy spectrum.

Current indications derived from metered data verify the presence of a low energy cosmic flux complemented with an increasing high energy cosmic flux as geomagnetic latitude approaches the magnetic equator. This hypothesis is empirically substantiated by the following representative data. At an altitude of 100 km over the magnetic equator, metered cosmic flux is 3000 particles/cm^2-sec-sterad whose range exceeds 1 gram/cm^2. In contrast, at 2200 km and high geomagnetic latitudes, a cosmic flux of 10^5 particles/cm^2-sec-sterad whose range exceeds .14 gram/cm^2 has been metered.

Preliminary analysis of metered data supports the hypothesis that primary cosmic intensity-geomagnetic latitude relationships display a respectable mirror symmetry about the magnetic equator. However, inconsistency has developed concerning the hypothesis advocating equal primary cosmic intensity along magnetic field lines.

This appears to be the experimental status with respect to current earth satellite metering activity. As continued earth satellites are placed in orbit, spatial distribution of primary cosmic radiation will be monitored and parametric relationships established. However,

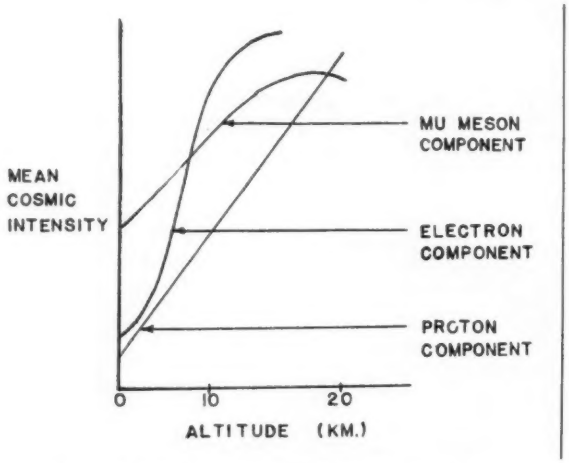
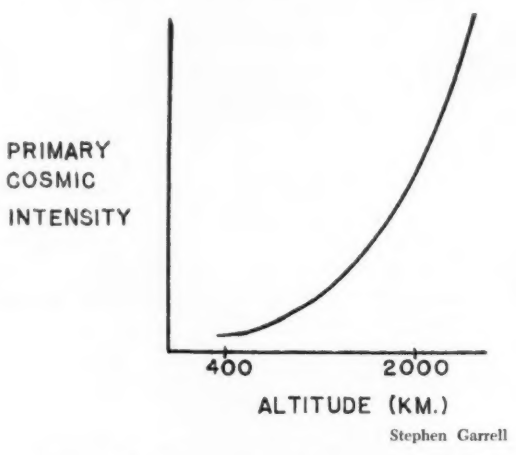


Figure 2. Secondary cosmic radiation *vs.* altitude.



Stephen Garrell

Figure 3. Primary cosmic radiation *vs.* altitude.

this represents a laborious task in technically digesting telemetered data and establishing significant empirical relationships.

Cosmic Countermeasures

The field of cosmic countermeasures for space vehicles has recently received attention fostered by a few unique proposals. It is generally accepted that an intensive corpuscular radiation belt exists in outer space. On this basis, several passive and active countermeasures appear appropriately effective, especially from the theoretical aspect. However, the application phase continues as a tremendous technical challenge.

Primary cosmic intensity may conceivably attain peak magnitudes approximately 10^5 times the maximum permissible human dosage of 5 roentgens/year. This speculative order of magnitude represents a phenomenal radiation environment to contend with. Space vehicle instrumentation appears considerably less vulnerable to this intensive radiation environment than humans. Consequently, countermeasure design must be capable of reducing cosmic irradiation to tolerable human levels, an essential prerequisite for manned space vehicles.

The most common method of reducing radiation intensity is through absorptive techniques, similar to those associated with x-ray absorption. X-ray absorption in materials is in accordance with the exponential absorption relationship: $I_a = I_o (1\text{-}e^{-\mu x})$ where I_o is the incident radiation intensity, μ is the linear absorption coefficient, and X is the absorber thickness. Since primary cosmic radiation is composed of charged particles, this well formulated absorption relationship is not applicable. Empirically derived relationships, referenced to equivalent X-radiation performance, may prove beneficial as approximative analysis techniques in charged particle irradiation studies. However, preliminary investigations estimate shielding mass requirements in the neighborhood of five tons of lead. This certainly reduces the attractiveness of this particle countermeasure.

Another unique countermeasure utilizes electromagnetic techniques. This suggests creation of an extremely powerful and highly concentrated magnetic field encompassing the space vehicle. This magnetic field would serve as a dynamic shield to deflect low energy charged particles and decelerate the highly energetic charged particles impinging upon the space vehicle. It has been estimated that self-contained generating equipment would require one million ampere-turns at thirty-six megawatts to create an effective dynamic shield. The implied massiveness of equipment associated with this proposal represents a discouraging element with respect to practicability.

A feasible solution may prove to be the optimal balance between absorptive and electromagnetic shielding techniques that minimize associated space vehicle mass. Continued investigation of practical cosmic countermeasures is assured as manned space vehicles approach reality.

Secondary Galactic Phenomena

The most paramount secondary galactic phenomena which may influence space vehicle performance are micrometeorites, aurorae and galactic radio emission. They are termed secondary because satellite monitoring of these phenomena to date have deductively indicated no apparent transient or permanent effects of relative significance.

Micrometeorites are minute meteoric particles with innate ability to rapidly radiate energy generated through interaction with the atmosphere, thus retarding evaporation. This unique attribute, due to the micrometeorite's large ratio of surface area to mass, permits it to penetrate the earth's atmosphere.

Micrometeorites are considered to originate from zodiacal dust which theoretically forms a uniform galactic continuum in the earth's orbit. These initiating particles possess large velocity vectors prior to physical contact with the earth's atmosphere. As these incident particles penetrate the upper atmosphere, they are decelerated considerably before appreciable evaporation is experienced and eventually fall slowly to earth in the form of very fine dust.

The scientific inquisitiveness attached to micrometeorite phenomena is the potential ballistic penetration and/or erosion hazard confronting space vehicle envelopes. Explorers Alpha and Gamma were instrumented with ballistic piezometers to monitor high-speed micrometeor impact intensities and spatial density. Measurements received indicate that these effects are of secondary importance and can be appropriately discounted.

Aurorae are relatively short-duration illuminations generally occurring at the higher geomagnetic latitudes and upper atmospheric strata. These illumination phenomena are characterized by low energy emission with a wide wave length spectrum. Generally, this wide illumination spectrum is emitted since the incident corpuscular energy range is respectively quite broad.

One hypothesis suggests that aurorae are caused by interaction of an ionizing corpuscular radiation when penetrating the upper atmosphere. Since aurorae appear exclusively on the shadowed side of the earth, the geomagnetic field of the earth is suspected as influencing this incident ionized stream of corpuscles coupled with other environmental characteristics.

Since aurorae are manifestations of high altitude ionization, it is anticipated that these aurorae may directly impede the propagation of electromagnetic waves; e.g., radar and radio waves. Consequently, this upper atmospheric phenomena represents potential disruption hazards to essential communication systems associated with space vehicles.

Galactic radio emission is a similar potential interference to communication systems associated with space vehicles. This electromagnetic phenomena is radio radiation generated by the electron synchrotron process. This hypothesis suggests that secondary electrons, and perhaps also positrons, produced by cosmic primaries, interact with weak magnetic fields occurring in stellar peripheries emitting radio waves. This is the peripheral stellar region where interaction does not permit optical radiation phenomena.

The physical phenomena underlying aurorae and galactic radio

(Continued on Page 50)

CONFESSIONS OF A DIRECTOR
OR
TWENTY YEARS BEHIND THE DESK

by Dr. Fred H. Rhodes

Dr. Fred H. "Dusty" Rhodes is founder and first director of Cornell's School of Chemical Engineering. He is well-known, not only as a leader in engineering education, but also as a pioneer in the development of the profession of chemical engineering. He was born in Rochester, Indiana in 1889 and graduated from Wabash College in 1910. In the same year he came to Cornell for his Ph.D. which he received in 1914. After several years in the chemical industry he returned to teach industrial chemistry at the University. In 1932 Dusty finally convinced the University that a chemical engineering degree should be offered, and in 1938 a separate School of Chemical Engineering was set up with him as first director. He served as director until 1957. His latest achievement has been his election to the University Board of Trustees.

This article is written in a well-meaning but probably ineffectual attempt to provide a guide to those who may suffer the hardship of being sentenced to the directorship of a school. It may enable them to avoid some of the rocks and shoals that beset their course. It cannot chart all of the new obstacles thrown up by subterranean administrative upheavals.

The director is supposed to be the mouthpiece of his faculty. The one thing that a faculty doesn't need is a mouthpiece—it has lots of them. He is also assumed to be a leader of the faculty. Every director should have had in his youth some farm experience. I remember one occasion when I, as a boy, tried to lead a bunch of pigs down a country road—not, I hasten to say, that I imply faculty members are pigs. However, mention of exerting leadership recalled the incident to me.

Faculty Meetings

One of the duties of a director is to preside at faculty meetings and to see that minutes thereof are kept. Here there are two schools of thought. Some directors hold faculty meetings at regular intervals. The first order of business is normally the presentation of committee reports. When a committee merely reports progress, it means that the chairman forgot all about his assignment, and the committee was never called together. A preliminary report indicates that the committee is hopelessly bogged down and doesn't know what to do or how to do it. A final report is submitted when either the more vocal educators have finally worn down the more conservative members, or the conservatives have stolidly outlasted the liberals until the latter have found a new interest.

When a final report is presented early in a faculty meeting, there is usually so much discussion and so much diversity of opinion that the report is referred back to the original committee or to a new one. A report submitted late in a meeting, just before dinner time, is commonly approved unanimously. After the committee reports comes the new business. This consists in appointing new committees.

Other directors hold faculty meetings at irregular intervals, and only when such meetings are unavoidable. They are called to approve actions already taken or commitments already made. Of course, some committee reports must occasionally be submitted and approved, but the procedure is greatly facilitated and accelerated if each appointed committee consists only of the director.

Conscientious directors keep full minutes of faculty meetings. Usually this does no harm, because the minutes are filed away and do not normally again see the light of day. There is, however, some risk that an objectionably inquisitive faculty member or one with a retentive memory may resurrect them. If no minutes are kept, they cannot be exhumed to embarrass the director when a change of conditions, or of thinking, makes consistency no longer a virtue.

Questionnaires

Much of a director's time is consumed in filling out questionnaires. A questionnaire is a troublesome pest, something like a mosquito on

a warm summer night. When it first appears, the victim is tempted just to keep still in the hope that it will soon go away—it never does. Soon letters or telephone calls arrive inquiring why it has not been returned. One's only relief is to dispose of it promptly. The invention of questionnaires is ascribed to a Spanish gentleman by the name of Torquemado who lived about five hundred years ago. Their recent popularity has, I suspect, been fostered by the manufacturers of filing cabinets.

Most questionnaires begin by asking, "What are your educational objectives?" One might expect the inquisitor to assume that the objective of a school of chemical engineering is to train competent chemical engineers, but that never seems to occur to him, nor does that simple answer satisfy him. The proper reply is, "To prepare qualified young men and young women for their most effective service to society." No one can quarrel with that, because no one knows just what it means.

Then the questionnaire demands a multitude of statistics. Some of these can be supplied after much search through dusty files. Others, as "How many students will enter your school in 1975?", are rather difficult to estimate with precision. A really conscientious director plots graphs and projects them far into the future. I regret to say, however, that some directors merely pick numbers from a table of logarithms. This is very reprehensible. It makes for inaccuracy, and it is needlessly unscientific, for most books on statistics contain valid tables of random numbers.

Public Relations

Then too, there is the broad field of public relations—relations with the students, the alumni, and the general public. Maintaining good relations with the students is rather easy as long as the fiction of infallibility is sustained, but if that veil is torn even slightly, the director stands revealed as just a person.

On one occasion I confessed before a class that I had once made a mistake. Of course, I added hastily, that was the time I thought I was wrong when I wasn't, but the harm had been done. Those boys ever afterward insisted on regarding me as a human being, instead of as a director.

To maintain good relations with the alumni, the director must be able to recall the name, class, and present address of every returning alumnus. This holds true even if he hasn't seen that alumnus for fifteen years, and the slender young man of years gone by has acquired a paunch, double chins and has lost most of his hair. Usually recognition isn't difficult, although sometimes the name doesn't come to mind instantly. In such case, a series of tactfully worded questions may supply a helpful hint. Occasionally such questions may lead to disaster.

Many years ago a re-unioning class adopted as its uniform blue dungarees and a blue shirt. I was in my office and wanted very much to see Dr. Winding, but every time I started for his office I met a blue-dungareed, blue-shirted alumnus. After we had talked for a while, he would leave, and I would start again to see Dr. Winding, only to meet another graduate of years gone by. Finally the coast was clear, but as I stepped into the hall I was confronted by still another elderly man in blue. His face was vaguely familiar, but I couldn't recall his name. I greeted him heartily, shook his hand, and asked the usual questions. The answers were satisfactory, but not informative—he was well, his family was well, he was still with the same firm, he still lived at the same place. Since I really did want to see Dr. Winding, I pressed the visitor into a chair and implored him not to

Enrico Sismondo

"Oh my! Carbide precipitation!"

leave. I would return promptly, and we could then have a good visit. When I came back, he was gone. My secretary was bent down behind her desk, apparently to tie a shoestring. When she emerged, red-faced, she managed to gasp, "Your friend had to leave. He was a janitor from the next building who brought over some papers."

There is, however, one problem in alumni relations that I never learned to solve. An alumnus of a few years' standing returns, you visit for a while, then he begins to fumble in his inside coat pocket. You sit frozen. You know what's coming, but there's no escape. He pulls out a small packet carefully wrapped in cellophane and tenderly extracts from it a photograph. You hope against hope that it's a picture of a new house or a new car or a new hunting dog, but you know full well it isn't. Cautiously you hold it before your dazed eyes. The exhibitor, who by that time is beaming over your shoulder, reaches forward and turns it around, saying, "No, you've got it upside down!" In panic you stare at the pictured infant. To your eyes, it looks like any other infant. You say something. Your desire to be courteous conflicts with your early religious training not to tell a falsehood. The silence lengthens beyond any period that can properly be ascribed to amazed admiration. You must say something. Finally you blurt, "Homely little chap, isn't it?" That is not the appropriate remark.

Relations with other faculty members do not usually create serious difficulties, although occasionally minor incidents do arise.

Some years ago, one of the exhibits on Engineers' Day was a polished specimen of steel. Viewed under the microscope, it showed the grain structure of the metal at an intermediate stage in heat treatment. The specimen was very skillfully prepared. To an observer familiar with metallurgy, it was very interesting. It must be confessed, however, that to one not acquainted in that field it looked, under the microscope, much like a badly cracked and somewhat fly-specked round mirror from a ladies' compact.

The professor in charge of that section of the exhibit was present to offer explanation, if explanation was requested, and to answer questions if questions were asked.

One after another, visitors entered the room, sat down, peered through the microscope, uttered a polite but uncomprehending "Mmm!", and then departed for other exhibits where lights flashed or wheels turned or bells rang. The professor grew more and more irked at the lack of appreciation by the public.

Then entered a very pretty little girl, about seven years old, with blond pig-tails and neat starched dress. She immediately approached the professor and demanded "I wanna see! Let me look!" The professor shushed her impatiently. When the visitor at the microscope rose and another took his place, she renewed her demands, only to be silenced again—if only temporarily.

Finally, when the last visitor had departed, the professor said "Oh, all right," lifted her to the chair, and told her to look down through the little hole at the top of the microscope tube.

She did as instructed, then looked up, clapped her hands, and cried with delighted enthusiasm, "Oh my! Carbide precipitation!"

The professor was dumfounded. He could not believe his ears. Excitedly he demanded, "What! What did you say?"

The little girl repeated "Carbide precipitation."

The professor was convinced that he had found a truly phenomenal intellect—a child who, even at that tender age, was familiar with the complex science of metallurgy. Unfortunately, it developed later that the young lady had been carefully coached, both as to behavior and as to comments, by a faculty member with a deplorably distorted sense of humor.

Maintaining good public relations with the general public involves, among many other things, answering many questions from people who come to the director for technical advice. Except when an excessive amount of time is needed to arrive at the answer, each inquiry deserves a full and considered reply. Sometimes, of course, there may be no satisfactory answer.

Some years since, a very attractive young woman who was then a secretary in one of the administrative offices presented a serious problem to a certain director. She had bought a rayon dress. (Rayon was then new and popular.) She liked the dress very much, except that when she walked across the floor the skirt stood out horizontally. She wanted a remedy for this. The director explained that this was caused by static electricity. The lady wasn't interested in the scientific explanation of the cause. She wanted the remedy. The director observed that gasoline trucks get rid of static electricity by dragging a chain attached to the rear bumper. The suggestion didn't appear to be a feasible one.

Above all, a director must always take his job, his colleagues and himself, especially himself, extremely seriously. Any unseemly tendency to levity must be sternly suppressed. He must never let it be suspected that he enjoys teaching and the privilege of continued association with generations of very fine and very wonderful young people, nor that sometimes he chokes a little with pride at the splendid achievements of the many graduates who have gone out from his school.

ELECTRONIC CHAUFFEURS

(Continued from Page 19)

system using detector loops buried in the pavement could be installed for use as a speed timing device at first and later be made part of a complete automatic control system on the highway.

"Tails" Warn Driver

A more advanced system using the detector loops but still requiring no special equipment in the automobiles is one in which signal lights would be placed at frequent intervals along the highway. A car passing over one of the detector loops would light a corresponding signal for a period of time. The length of the "tail" or minimum distance between cars could be made proportional to the speed of the first car by making the signals persist for a certain length of time after the first car had passed over the detector units near them. Another method would be to make the distance equal to some other function of the first car's speed by the use of computers to determine

the time interval the light would stay on. Thus, there would at all times be a "tail" of warning lights behind each vehicle. This type of system is especially applicable in areas of low visibility due to hills and turns. It would be equally useful for lights to signal a warning to drivers approaching in the opposite direction. This arrangement could eliminate most of the risk of passing on two- or three-lane roads. A complete system would operate similarly to a railroad block system.

As the mechanical reliability of these systems is increased, the "tail" of lights could be replaced by a radio "tail." At first the radio system would operate lights or buzzers in the automobiles. Later the radio system would operate power steering and brake systems in the car, and the unit would be completely automatic. The intensity of the radio wave given off at a point could be made to vary with the length of time following the passage of the first car over the spot so that the rate of increase of intensity of the radio beam could, when fed through a computer, determine the rate of approach of the second car. The overall spacing and speeds of the cars could also be made adjustable so that they could vary with road conditions. In this way, the highways could always be used to maximum advantage and with maximum safety.

Electronics To Control Steering

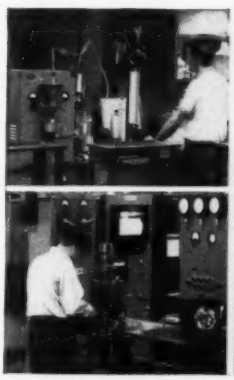
In addition to speed control there is a related method for automatic steering. General Motors and RCA are cooperating in the development of a system in which a cable buried in the center of the highway lane carries an alternating current. Two pickup coils are mounted on the front of a car so that each will receive a signal from the cable. These signals are arranged so as to oppose each other. With the two coils equally distant from the cable, each receives the same voltage and there is no current in the circuit. However, if the car happens to waver to one side, the voltage induced in one coil increases while that in the other decreases and a current flows in the circuit. This current then serves as a signal to computers which operate the power steering mechanism to center the car on its path again. Thus the car proceeds along its own lane with only infinitely small displacements to either side. If, at a certain point, the driver wants to choose between two roads or turn off onto the shoulder, he simply throws a switch to return the car to manual control and takes over the steering himself.

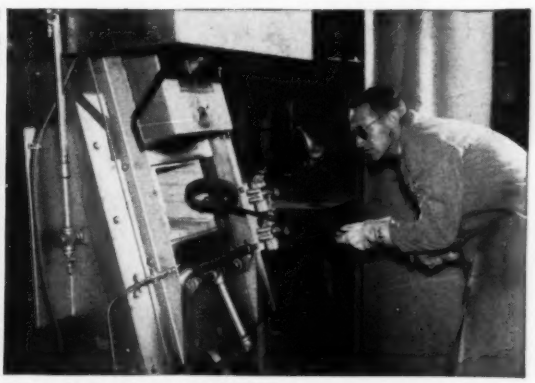
A completely automatic system including the automatic steering control system, the automatic radio-controlled speed control system, and the speed control signal light system is being tested on a short three-hundred foot stretch of road constructed by the Nebraska Department of Highways. There is also a one mile loop of test track at the General Motors Technical Center on which a car may be steered by means of the cable in the center of the highway.

Automation To Come Gradually

It would be impossible to convert all the automobiles to automatic control simultaneously. Therefore, any highway constructed for automatic guidance must also function for cars not specially equipped. Since the detector loops in the pavement are activated when any automobile goes over them, regardless of equipment, manually controlled cars could fit in perfectly with the automatically guided ones on the same highways. This is one of the main advantages of the system now being developed.

Obviously, the testing of these devices is still very much in the experimental stage. Primarily those difficulties relating to dependability must be solved before complete automatic control systems can become common on our highways. In the meantime, systems like Ford's "vehicle approaching" device and radar braking systems will probably be put on the market. The block system using detector loops and warning lights need not be too far in the future, since it requires no special equipment in individual vehicles. Most authorities agree that complete automatic control is possible, and that with continuing cooperation between the electronics industry, the automotive industry, and the highway design industry, it will become a reality.





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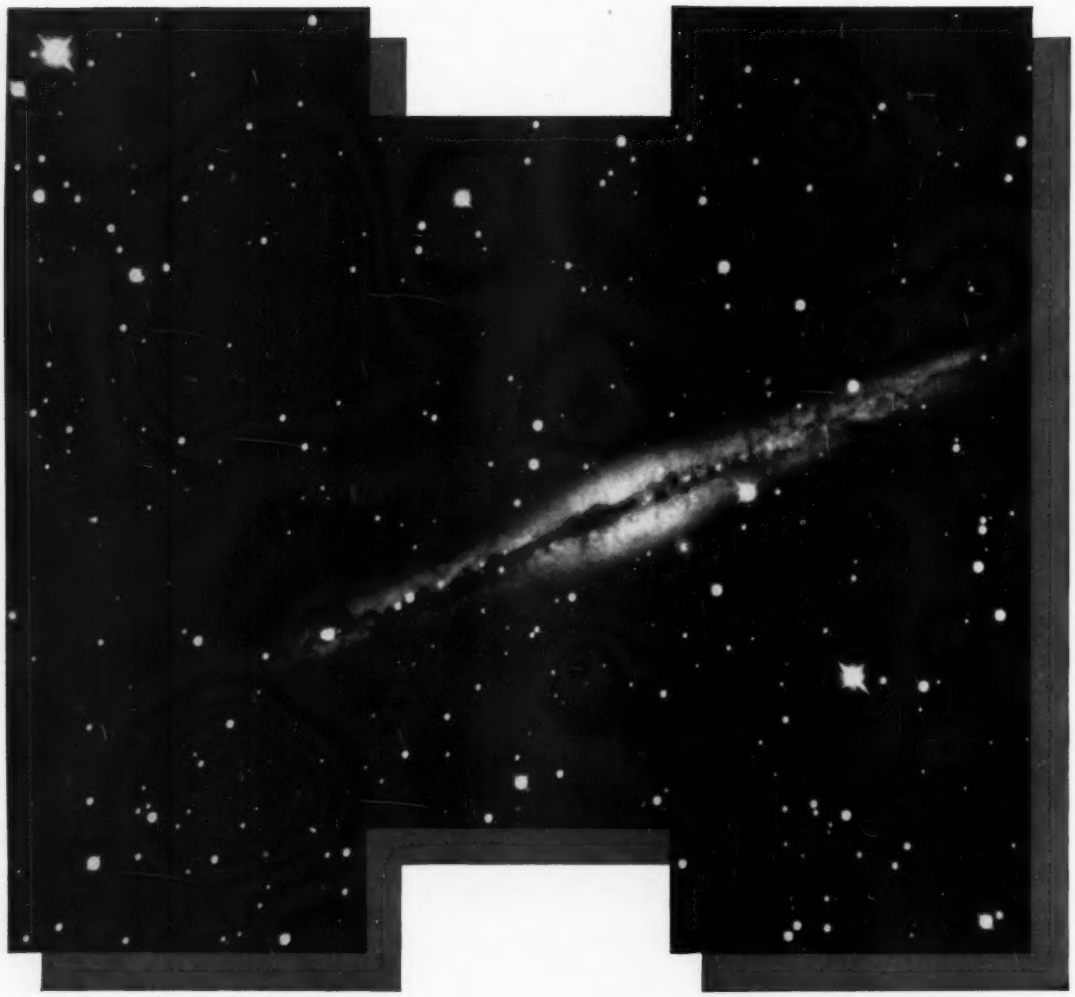

FOR THE SPACE AGE

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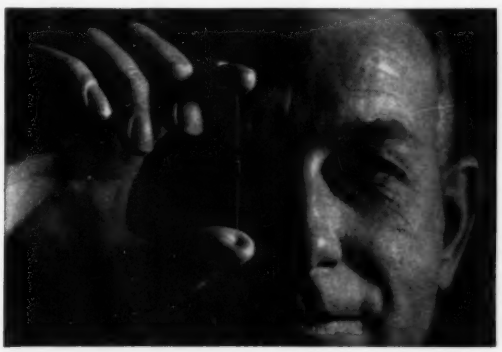

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FIFTY YEARS AGO IN THE ENGINEER

For almost every engineering student nowadays, at Cornell at least, it has become second nature to work all his computations on the slide rule. Some older engineers who learned the rudiments of the profession before the introduction of this time saving little device are inclined to question the accuracy of its results. The writer recalls the visit to the office in which he was employed several years ago of an old county surveyor who became interested in the workings of the instrument and proposed several problems to be worked out. The speed and accuracy with which they were done (being usually estimated successfully to the fourth figure) brought much pleasure and astonishment to the old man.

We believe that one of the most valuable parts of a young engineer's preliminary training is the art of using a slide rule rapidly and correctly. There is another side to the question however which is illustrated by the story of the professor who became such a devotee of the slide rule that he was never found without one about him. Finding it necessary one day to perform the operation of multiplying two by two, he pulled his slide rule out of his pocket, carefully made the setting and said, "Three point ninety nine, call it four."—(*The Cornell Civil Engineer*, December, 1908)

Of all men the Engineer is, by training, the most logical. If he would give but a small amount of the time he gives to problems of mathematical nature, to the problem of writing good English, there would be much less harping on the poor English written by Technical students.

Before he tackles a problem in algebra, he knows what he wants to find out from what he has given to him. In geometry, he starts off with a theorem which is a concise statement of what it is intended to prove; then come the facts on which the proof is built (the "given" part) and finally the proof itself. Thus before he attempts his proof he has before him what he wants to prove and by what means he will arrive at that proof. Accordingly his statements are absolutely logical, including nothing irrelevant to the subject at hand. Why is it then, that when a man is asked to write an answer to the question "Why is the steam engine compounded?" he opens his examination blank and proceeds to put down all he knows, as fast as he can write, without making any attempt at coherence or logical order. What is the result? His paper has no beginning or ending, and often contains a lot of unnecessary information. If then five minutes spent in preparing his ideas for expression, not only puts them in their logical order, but eliminates those not asked for he has saved his own time. And time in an examination is valuable.

In a little booklet published by the American Institute of Electrical Engineers, some hints on the preparation of manuscript are given to authors. It is suggested that to secure logical sequence of thought and unity, a pack of cards of three colors be used in the following way: On those of one color write down at random thoughts, phrases and suggestions suitable for the introduction. On those of the second and third colors jot down similarly, suggestions for the body of the composition and conclusion respectively. It then becomes necessary to sort these cards. "This can be done deliberately, as deliberately as sorting a hand at whist. In this way matters that belong together can be put together, matters that have no immediate connection can be kept apart." Of course this method is far too elaborate for the everyday needs of the student. Let him replace the cards by a piece of paper divided by lines into three sections. In each section he can jot down thoughts and notes as with the cards. From such an outline, he can pick what is required by the subject under discussion, and readily arrange them in proper order either in his mind, or by numbering them on the paper. As yet Cornell Engineers are not graded for their English. We do not think it necessary. Only let a man remember that by spending a few moments preparing his thoughts for paper, he will do himself more justice, and in the end save himself time by not going off the topic, and we feel that there would be less heard about the poor English written by Engineering students.—(*The Sibley Journal of Engineering*, October, 1908)

By a simple method, it is proposed to produce a continuous air cushion under the boat by means of a machine pumping the air through the bottom of the craft, the result being that the boat practically rests in this medium and consequently passes through the water with a minimum of friction. . . . The general method of causing the air to get under the boat is by forcing it through the bottom along the keel bow below the water line, so that as bubbles rise they will make

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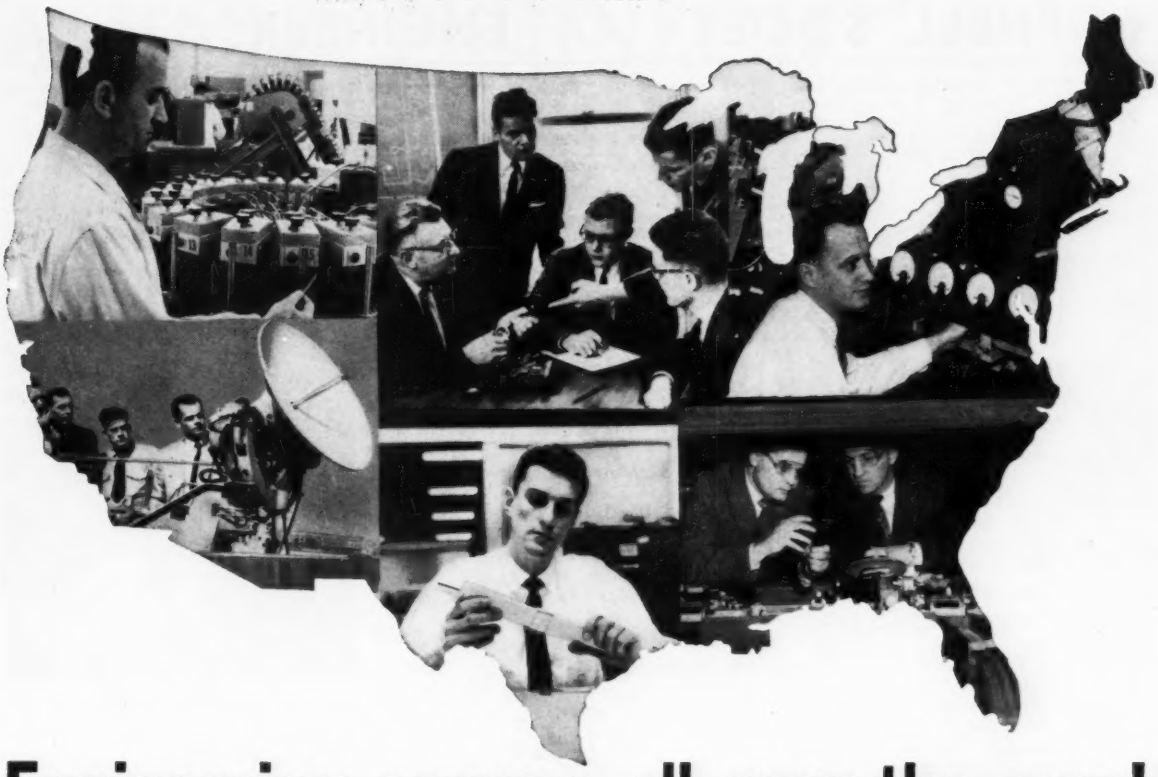

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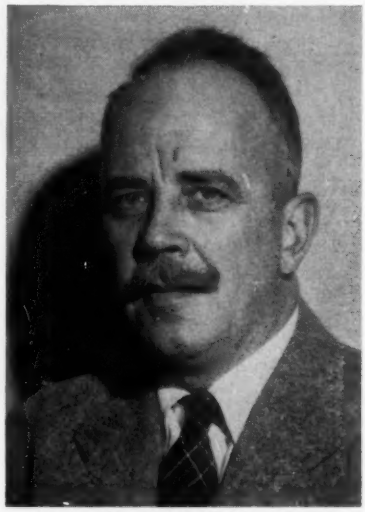


Roscoe H. Fuller

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students, and to establish closer relationship between the College and its alumni."

The President's Message — ALUMNI INTEREST

Many persons are unaware of the degree to which our University concerns itself with its alumni, of the effort which is expended in these concerns, and the number of different bodies which are involved.

Cornell is fortunate in its charter, which provides that ten of the forty-five trustees are to be elected by the alumni (two each year, for five-year terms). This is intended to assure a high degree of consciousness of alumni opinion. Since the alumni constitute a large body of individuals, widely scattered geographically and professionally, the benefit of this sort of representation is obvious.

Under the Board of Trustees comes the Office of University Development, which operates in all those fields of University affairs not directly within the scope of faculty or administration. This office interests itself in sponsored research, the Cornell University Associates, the Cornell Aeronautical Laboratory, the Cornell University Placement Service, and advance planning for the University, among other things. It is to this division that the Alumni Office and the various fund-raising agencies report.

The Alumni Office is the agency with which as alumni we are perhaps the most familiar. It is the place to which we normally write for information or assistance regarding questions to do with our University. It maintains a dedicated, able and efficient staff and a complete address list of living alumni. It is headed by the Alumni Secretary, who is an officer of the University, and who also serves as Secretary of most other alumni organizations. This office takes care of the manifold problems involved in the logistics of class reunions. Through the Federations of Cornell Clubs it sponsors and assists with the organization of local clubs. It also helps in Class organization and in attracting desirable students to Cornell.

The Cornell Alumni Association is the general association of the alumni of the University. It is controlled by a board of directors consisting of the Presidents of the Federated Clubs and the various College Associations, the Chairmen of the University Council and the various standing committees, and others, including the Alumni Secretary and the University Vice President for Development. Through representation on this board it provides liaison among the organizations concerned with various phases of alumni affairs and a direct and responsible pipeline from the alumni to the highest echelons of University administration. It is this association, through its board of directors, which controls the Alumni News, the mechanics of the election of Alumni Trustees, and the standing committee on secondary schools, which works with the secondary schools committees of local clubs in presenting the advantages of Cornell to prospective students and their guidance counsellors.

The Cornell University Council concerns itself with the general welfare of the University, and in particular controls the various fund-raising activities. Among its interests are coordination between the different branches of the Alumni Fund and the various special funds and donations for specific purposes.

The Engineering College Council is one of several College bodies with similar purposes. It provides advice and assistance to the faculty and administration of the College of Engineering but ordinarily concerns itself less with fund-raising than does the University Council. Currently, however, it is sponsoring the Engineering Development Fund, needed to complete the engineering center at the south end of the campus. A member of this council is elected annually by the Cornell Society of Engineers.

The Cornell Society of Engineers, to membership in which all engineering alumni are eligible, is an independent organization not subject to direct control by the University. Similar organizations exist in connection with other colleges and schools within the University. Being independent of University control offers a freedom of action which conceivably might be useful, although our policy is to work in close coordination with the Office of University Development, the Engineering College Council and the Alumni Association, to the mutual benefit of all.

From the rather sketchy outline above from which a number of details have necessarily been omitted, it may be seen that the areas of interest of the various bodies overlap. This is purposely done, I think, both to ensure close liaison in areas of mutual interest and to ensure that no function having to do with the inter-relationship between the University and its alumni will be neglected.

It will perhaps be clear from the above that our University values highly the interest and support of its alumni. No reasonable effort is too great to obtain the benefit of their advice. Their continued interest is a major concern of the Administration.

—ROSCOE H. FULLER

ALUMNI ENGINEERS

Brigadier General Wesley T. Guest, EE '21, has assumed command of the Sacramento, Cal. Signal Depot. After graduating from Cornell, he was appointed a second lieutenant in the Signal Corps of the Regular Army, August 4, 1921. During World War II, he was assigned to the Office of the Chief Signal Officer and in 1944 became director of the Communications Zone headquarters in the European theater. In 1945, he served in the Southwest Pacific in the Office of the Chief Signal Officer for that theater. In 1951, he went to Korea to become Signal Officer of the Eighth Army. His last previous command was as Signal Officer for the U.S. Army, Europe. He has been awarded the Legion of Merit with Oak Leaf Cluster, the Bronze Star Medal, the Air Medal, and the Distinguished Service Medal in recognition of his performance and duty in the Korean conflict.

Whitford S. Wyman, ME '28, has been appointed president of Linde Air Products Co., division of Union Carbide Canada Ltd. Mr. Wyman joined the Linde organization thirty years ago, following his graduation. He has held various positions in research, development, and plant supervision. Since 1956, he has been vice-president and general manager of Linde Air Products Co.

Whitford S. Wyman

Harold B. Maynard, ME '23, is one of the engineers covered in a book Modern American Engineers, by Edna Yost and published this year by J. B. Lippincott Co. He is described as "industrial engineering consultant and president of the Methods Engineering Council which specializes on management problems in industry." Mr. Maynard has been awarded the Gilbreth and Melville medals and has also received the Wallace Clark award for outstanding contribution to management in the international field. He holds an honorary doctorate from the University of Miami.

Frank O. Agel, ChemE '26, has been appointed vice-president in charge of development of the nitrogen division of Allied Chemical and Dye Corp. Mr. Agel has been director of development, supervising the division's research and engineering program. He has been located at the nitrogen division's development center in Hopewell, Va. and will continue in that location. With Allied since 1927, Mr. Agel has been principal chemical engineer, assistant to the director of development, and director of organic development. He was appointed director of development in 1954.

John W. Root, Arch '09, senior partner of Holabird and Root and Burgee, architects-engineers, Chicago, Ill., is the winner of the 1958 Gold Medal of the American Institute of Architects. The highest honor of the Institute, the award is in recognition of the most distinguished service to the architectural profession or the Institute. He is the seventeenth American and the first Cornellian to receive the honor. Mr. Root became a Fellow of the AIA in 1937 and served as the first chairman of its important public relations committee. He has served as a member of the Chicago Plan Commission and chairman of its planning committee. Other honors he has received include the French Legion of Honor.

Kenneth M. Lord

Kenneth M. Lord, EE '36, has been appointed director of engineering in the electronics division of Stromberg-Carlson, Rochester. After Mr. Lord's discharge from the Navy as a lieutenant commander in 1945, he founded the Lord-Taber Co., an electrical manufacturing firm in Canandaigua. He served as its president until 1949 when he joined the General Electric Co., where he had a variety of executive positions before joining Stromberg-Carlson.

Donald A. Booth, CE '35, has been promoted to assistant engineering manager for Engineering Works Division of Dravo Corporation. Mr. Booth joined Dravo as an engineer soon after his graduation from Cornell. His career has included experience in field engineering, costs, plant and industrial engineering and numerous supervisory posts. For several years he was general mechanical superintendent of Engineering Works Division and was named chief draftsman in 1956. Mr. Booth is a member of American Society of Civil Engineers, the Society of Naval Architects and Marine Engineers and Tau Beta Pi and Chi Epsilon, honorary engineering fraternities.

Henry Marx, ME '79, chairman of the board of G. A. Gray Co., Cincinnati, Ohio, celebrated his

(Continued on Page 50)

START TODAY TO PLAN TOMORROW

By knowing about some of the projects underway at the Babcock & Wilcox Company, an engineer may see his personal avenues of growth and advancement. For today B&W stands poised at a new era of expansion and development.

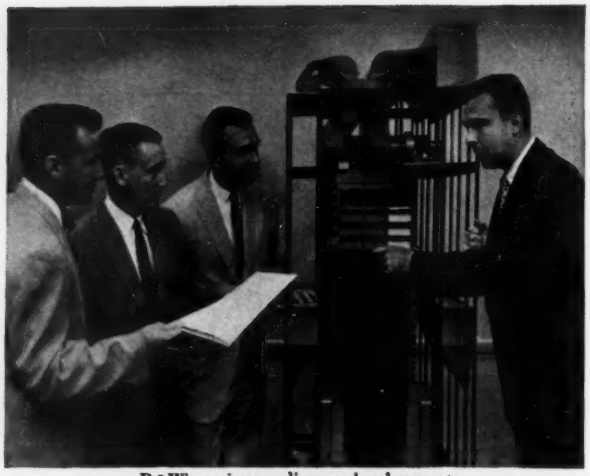
Here's an indication of what's going on at B&W, with the consequent opportunities that are opening up for engineers. The Boiler Division is building the world's largest steam generator. The Tubular Products Division recently introduced extruded seamless titanium tubing, one result of its metallurgical research. The Refractories Division developed the first refractory concrete that will withstand temperatures up to 3200 F. The Atomic Energy Division is under contract by the AEC to design and build the propulsion unit of the world's first nuclear-powered cargo vessel.

These are but a few of the projects — not in the planning stage, but in the actual design and manufacturing phases — upon which B&W engineers are now engaged. The continuing, integrated growth of the company offers engineers an assured future of leadership.

How is the company doing right now? Let's look at one line from the Annual Stockholders' Report.

CONSOLIDATED STATEMENT OF INCOME
(Statistics Section)
(in thousands of dollars)

1954	1955	1956—UNFILLED ORDER$ (backlog)
$129,464	$213,456	$427,288



B&W engineers discuss developments in the Universal Pressure Boiler.

Ask your placement officer for a copy of "Opportunities with Babcock & Wilcox" when you arrange your interview with B&W representatives on your campus. Or write, The Babcock & Wilcox Company, Student Training Department, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

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Starting Salaries

The Engineers and Scientists of America have conducted a study of the trends in starting salaries of new graduate engineers. From the data available we have prepared recommended minimum starting salaries for various levels of experience and class standing.

Copies of this recommended minimum standard have been sent to your Dean of Engineering, Engineering Library, Placement Director, and Chairmen of the Student Chapters of the various Technical Societies.

We would be happy to send you a complimentary copy.

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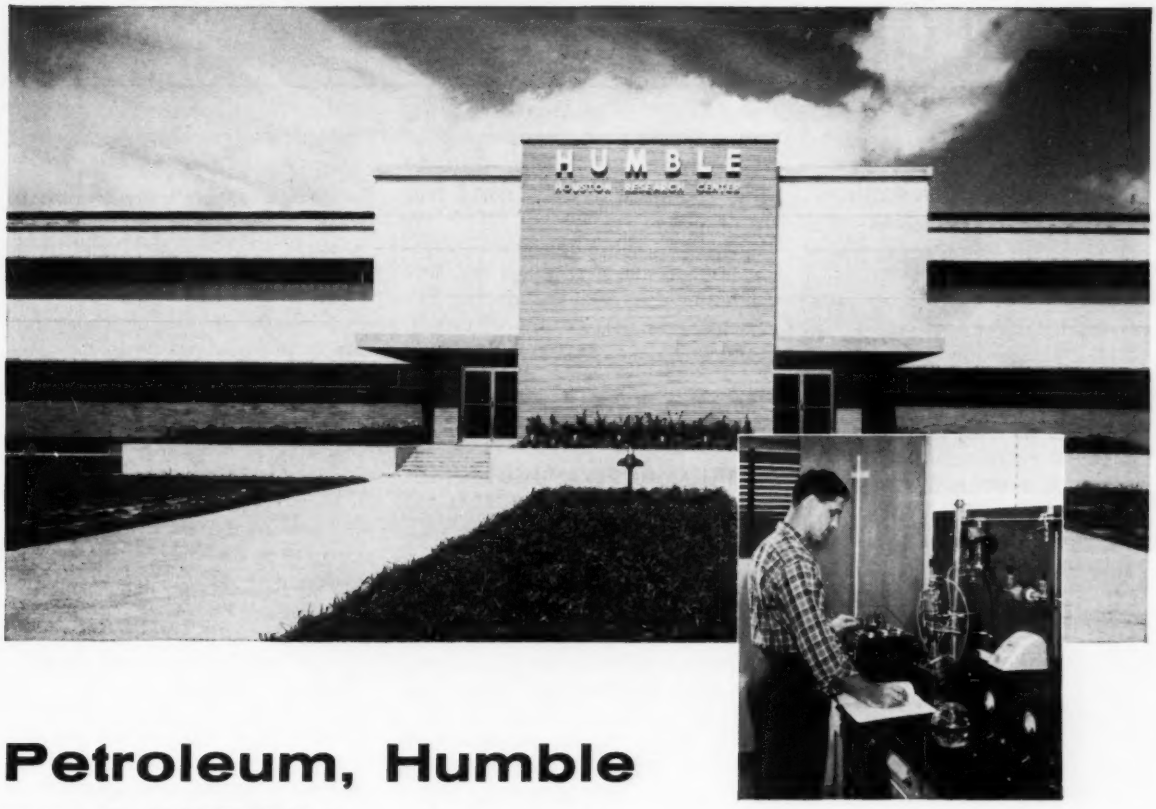

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Because of their importance to the petroleum industry, engineers and scientists are given every opportunity for professional growth and personal advancement at the Humble Company. Guidance, lectures by leaders in various fields, and membership in professional societies afford each man valuable means of self-improvement.

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A QUICK LOOK AT THE HUMBLE COMPANY

Area of Operation:	Texas, New Mexico, Florida, Alabama, Georgia, Mississippi, Louisiana, California, Washington, Arizona, Oregon, Alaska.
Refining Capacity:	280,000 barrels daily.
Retail Sales:	Texas and New Mexico. Leading Texas marketer.
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COLLEGE NEWS

CORNELL ENGINEER ANNOUNCES RECIPIENT OF ITS SCHOLARSHIP

This magazine announces the recipient of THE CORNELL ENGINEER Scholarship for the 1958–59 school year to be George A. Ruger, ME '60. The scholarship is awarded to an engineering student who, at the time of application, has completed his second or third term, is in the top half of his class, and has shown interest in extra-curricular activities. After these qualifications are met, financial need is the determining factor.

Although the amount of money depends upon THE CORNELL ENGINEER's income, the usual amount is $150 with a tenure of one year.

Each year a different school is connected with the scholarship. THE CORNELL ENGINEER has determined this cycle starting with the year 1955–6, to be as follows:

	Year		
ME	1	6	ME
EE	2	7	EE
CE	3	8	EP
ME	4	9	ME
ChE-MetE	5	10	ChE-MetE

The choice of recipient is made by either the University Scholarship Committee or a scholarship committee directly connected with the school concerned.

PROGRESS OF ENGINEERING DEVELOPMENT IN MOVIE

In order to show the progress of the Engineering Development Program, a new film, "Report on Engineering Development Program," is now available for alumni use. This is a professionally photographed film with sound and color that runs forty minutes on a sixteen millimeter projector. The film introduces Cornell with a short tour of the suspension bridge. The introduction precedes a treatment of engineering education. Featured are scenes showing students working in some of the new engineering buildings and examples of notable engineering achievements. The last few minutes of the film discuss engineering education of the future and the additional facilities which will be required.

Some of the more expedient requirements are: to finish the new buildings, to build a nuclear reactor, to build a metallurgy center, and to build a new foundry.

The Development Program had been the organization behind the creation of the new quadrangle.

SCHOLARSHIPS EXAMINED REGARDING INCREASED NEED, FEDERAL AID

The increased need for financial aid despite a reduction in the number of applications for assistance has made it necessary to re-examine the basis of making scholarship awards. Four steps are being taken to make more effective use of our scholarship funds. First, all students who apply for aid must now submit confidential financial statements from their parents on forms provided by the College Scholarship Service. Heretofore these have been required only from entering scholarship students. Second, in computing a student's need the self-help factor has been increased, so that more in the way of earnings contributory to his expenses will be expected of every scholarship applicant. Third, earnings from term-time employment will be more carefully scrutinized and reckoned as one of the student's resources in computing his need. Fourth, students registering automobiles on the campus will not be permitted to receive grants based primarily on need; those who hold merit awards, based primarily on scholastic achievement, will be obliged to accept the minimum stipend provided for the award they hold. Some exceptions will be made for those for whom possession of an automobile is a necessity.

The implementation of these steps will be helped by the establishment of the new University Office of Financial Aid. The Director of this new office is setting up centralized records of financial aid to students, including student employment and loans, which will make it possible for the scholarship committees throughout the University to be more realistic in determining a student's need and meeting it with the resources available to them.

While the amount of scholarship aid from industrial companies and foundations increased this year for engineering students by nearly $6,000, due in part to the establishment of new awards, substantial aid was withdrawn, presumably as a result of the business recession, but apparently also in part in anticipation of the entry of the federal government into the granting of aid to college students.

There is in the minds of a number of corporations and foundations the problem of what to do with their scholarship programs when and if the federal government sets up a schedule of financial aid to students. The question is how one can justify to his stockholders substantial contributions for scholarships if the problem of financial aid to students is to be adequately recognized by the government. It has been explained to a number of donors that whatever the federal government is likely to do in recognizing financial need for college students, the establishment or continuation of prize awards with fixed stipends for upperclassmen with distinguished academic achievement will provide an incentive to high quality performance which should upgrade any student body and increase the quality of the product which the colleges annually turn over to industry and the professions.

Although compared with other divisions of the University, the College of Engineering is liberally provided with scholarship funds, it is still unable to render more than token assistance to students who rank below the top third of their class. Thus for the most part, the rank and file students who form the backbone of the student body must necessarily be those who can afford unassisted the high costs of a Cornell education, and it would not be surprising, considering also

the five year program, if financial need and the inability to cope with it adequately may not be a primary reason for the severe reduction in applications for admission this year.—from Report on Scholarships for year ending 30 June 1958.

N.Y. TELEPHONE AND EE MERGE RESOURCES TO TRAIN ENGINEERS

For the second year, the School of Electrical Engineering will be the site of a training program for engineers employed by the New York Telephone Co. The program, entitled "Communication Engineering," will cover advanced topics pertaining to the telephone industry. The course will be run continuously throughout the school year, but each individual will attend three separate three-week sessions. Although regular faculty members will assist, the bulk of the instruction will be given by four retired New York Telephone Co. engineers.

CAL DESIGNS APPARATUS FOR TESTING FLYING JEEPS

Studies conducted for the Army at Cornell Aeronautical Laboratory, Inc. indicate the feasibility of constructing an apparatus to determine the static and dynamic flying characteristics of such small rotorcraft as flying jeeps and flying platforms.

The results of these studies indicate that a reliable and versatile experimental apparatus can be constructed with which accurate aerodynamic data on small rotorcraft can be obtained.

The test apparatus consists of a special towing vehicle, a large flatbed trailer with a mast for mounting the test rotorcraft, and a telemetering van to collect data.

The test apparatus would be able to test rotorcraft under many of the various conditions of operation. It would isolate the balance system and supporting structure so that road roughness will not affect the results. An external power source of about 350 horsepower would be available for test purposes.

The tilt-wing vertical take-off and landing airframe might also be investigated with this apparatus. It should be able to test reduced scale versions of the short take-off and landing airframes.

Cornell Aeronautical Laboratory is now completing the detail design studies. Fabrication should begin soon.

The development of the test apparatus is important, CAL and Army spokesmen declare. Full-scale testing in wind tunnels is expensive and these tunnels are not readily available.

To instrument and fly an experimental model is potentially dangerous when flying characteristics are unknown and the limited capacity of these small vehicles permits only rough instrumentation.

THREE CORNELL STUDENTS RECEIVE GE FELLOWSHIPS

The General Electric Company's Educational and Charitable Fund has named the recipients of its fifty-four graduate fellowships for the 1958-1959 academic year. The fellowships have been granted to students in the fields of engineering, the physical sciences, psychology, mathematics, economics, finance, and political science.

All of the students were selected by the engineering schools and universities to which the Fund assigned the fellowships.

The fifty-four fellows receive stipends ranging from $1750 to $2500 a year, depending on their marital status and dependents. Tuition and fees are also paid. In addition an unrestricted grant of $1000 is made to the institution where each of the recipients is studying.

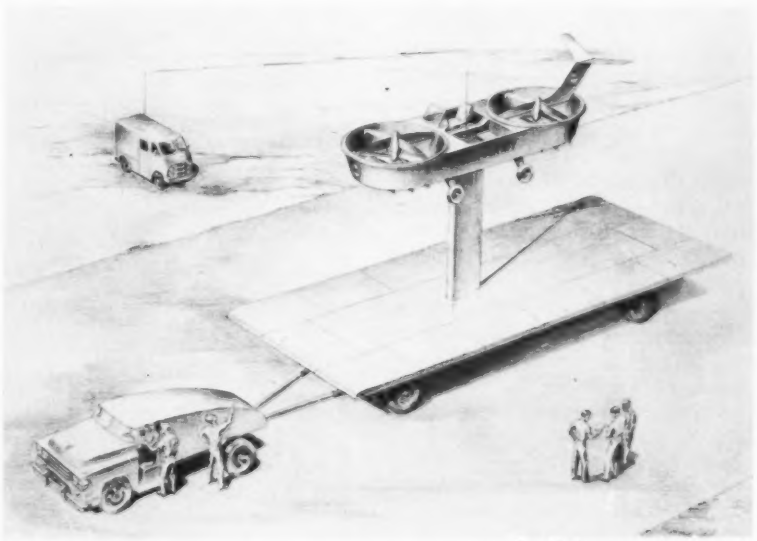
The Cornell students who received the grant this year are Vernon E. Buck, Richard C. Schoonmaker, and William Kement, Jr. Their respective fields of study are Industrial and Labor Relations, Chemistry, and Physics.

The Fellowship program is one of several which comprise the Fund's overall aid-to-education program which in 1958 will expend more than a million dollars for educational support. Approximately another half million dollars in aid for higher education is provided directly from funds of the General Electric Company.

FROSH ENGINEERING ENROLLMENT REFLECTS RECESSION REACTION

The College of Engineering's undergraduate enrollment has dropped a total of 103 from last year; this includes a decrease of eighty-eight in the freshman class. The decreases took place only in the ME, CE, and ChE Schools; the other schools record a slight increase. The drop, according to Dean S. C. Hollister is attributed to the reaction of many would-be engineers to the layoffs caused by defense spending cuts in the face of the recession earlier this year. However, Dean Hollister sees no trend connected with these figures.

The number enrolled in work for masters and doctorate degrees in engineering fields has increased by thirty-six since last year.



Cornell Aeronautical Laboratory

The trailer is pulled by a truck while a separate instrument van controls the rotorcraft operation.

Research at Cornell . . .

SURFACES STUDIED BY ELECTRON MICROSCOPY

An old standby found in outdated textbooks of physics and chemistry states that no one has ever seen a molecule. But the arrival of the electron microscope has actually enabled scientists to see and photograph molecules of some high molecular-weight organic compounds. The advent of the electron microscope has furthered knowledge in diverse fields from bacteriology to high-polymer plastics chemistry.

Professor B. M. Siegel, of the Cornell Physics Department, is using the electron microscope as one of two fundamental tools to study the surfaces of solids. The other tool is electron diffraction. The results of his study will also include better techniques of electron microscopy.

Beam of Electrons the Illuminating Agent

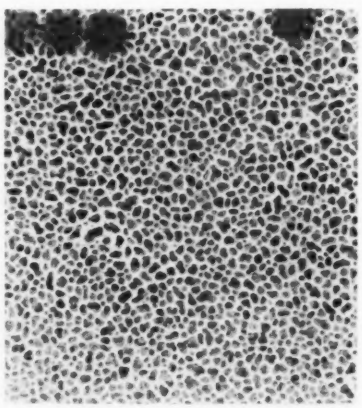
The electron microscope is roughly analogous to the ordinary light microscope, but instead of light a beam of thermionically emitted electrons is the illuminating agent. In viewing under the light microscope contrast is provided by spectral absorption of the transmitted light by the colored portions of the specimen. If contrast in the electron microscope were provided in this way, electron microscopy would be impossible, for the specimen would absorb energy and become hot.

However, the electrons impinging on the specimen are scattered, generally elastically, by small amounts of material in the specimen. The degree of scattering is dependent on the nuclear density of the material doing the scattering. The scattered electrons of course move away from the beam of illuminating electrons. These scattered electrons are cut off from the transmitted beam by means of an aperture.

A fluorescent screen may be used to form the image. If many electrons have been cut off (the specimen is dense), the screen will be dark. If few electrons have been cut off, the screen will be light. In this manner an image of the specimen is formed on the screen, an image which is a shadow image; dense areas light, light areas dark. If a photographic plate receives the image, a positive image is formed: dense areas dark.

Actual Surfaces Cannot be Studied

The specimen viewed under the electron microscope must be very thin. Most materials cannot be sliced to the order of thinness required, so a replica of the surface to be studied is prepared. A thin film of plastic is sprayed on the surface, allowed to dry, and peeled off. To increase contrast of the various areas of the specimen, thin films of metal, sometimes uranium, are evaporated onto the film. The thickness of the metal, called the shadowing agent, is on the order of 100 Angstrom units. (1 Angstrom unit is 10^{-8} cm.) Due to the high nuclear density of the metal, areas with metal deposited will be seen as light areas, in the manner indicated above.



Copper crystals are deposited on mica at a temperature of 425 degrees centigrade. The disks at the top are polystyrene latex, used to compare sizes. Note the parallel dark bands on some crystals; these are electron interference fringes caused by stacking faults in the crystals.

One phase of Professor Siegel's study involves finding better shadow casting techniques. His preliminary findings indicate that the granularity of the shadowing agent plays an important part in the contrast achieved.

Another phase of the study is to find methods to achieve better resolution. Resolution is the ability to see as two distinct particles two particles which are very close together.

What could some of the practical results of this study be? Copper in contact with air oxidizes. The nonconductive oxide film could cause an open circuit in an inertial guidance system of a missile. This study may reveal the mechanism of oxide formation, or its depth. The better techniques for shadowing may be used in the biological sciences, perhaps to obtain better pictures of viruses.

Assisting Professor Siegel are Dr. Louis Bachmann, research associate, and Mr. Charles Peterson, graduate student. The grant is from the United States Air Force.

by William J. Krossner, ChemE '61

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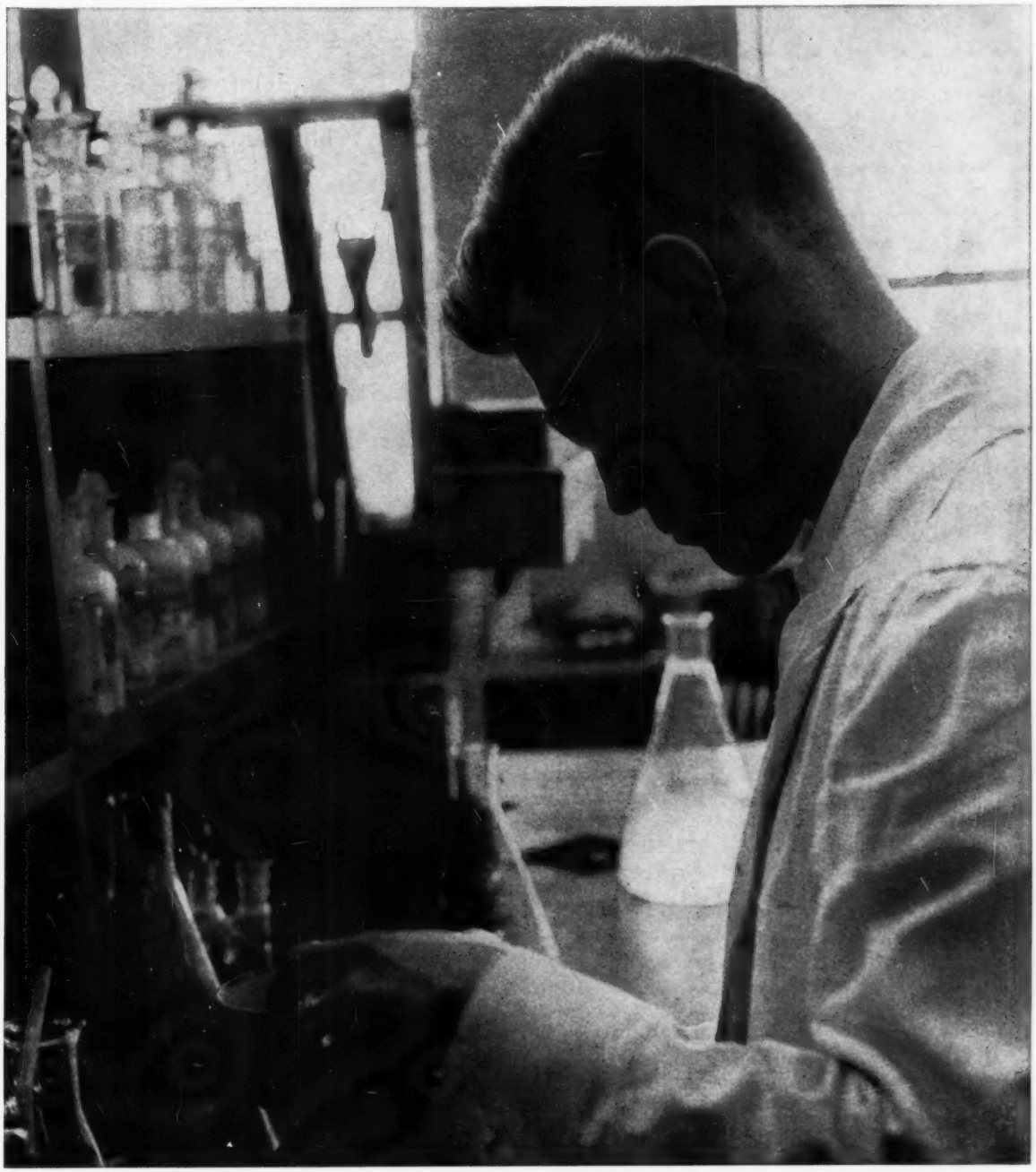

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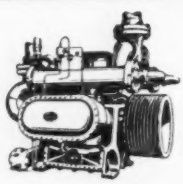

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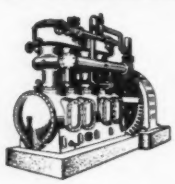

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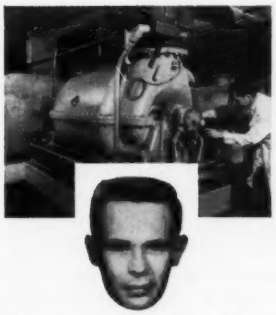
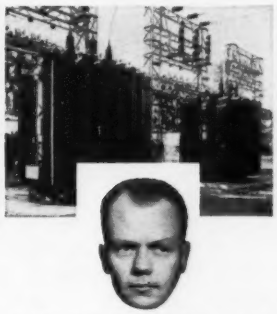
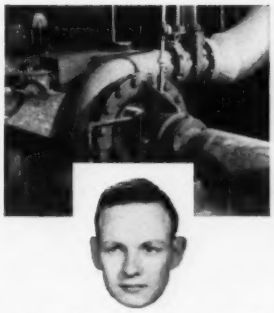


Aeronautical engineer Robert Claude, Parks College of Aero Technology, BS Aero Eng. '50, engineers compressors for wind tunnels.



Application engineering on large power transformers is handled by Michael Waterman, Case Institute of Technology, BSEE, '47.



Sale of large centrifugal pumps to a wide range of industries is directed by Howard Godfrey, Oregon State College, ME '48.

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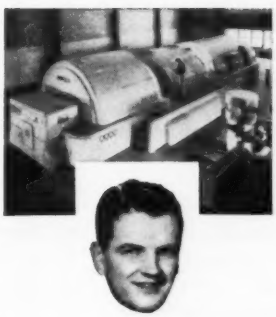
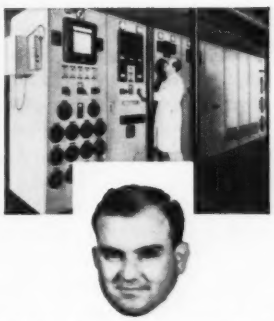
proved excellent springboard to

Sales and promotion man Irving Fisk, Clarkson College, EE '52, works with large power circuit breaking equipment.



Sales manager of large steam turbine generator units is interesting specialty of John M. Crawford, Clemson College, BME '49.



Sales engineering of high voltage electrical control is specialty of Ernest Horne, graduate of Alabama Polytechnic Institute, EE '49.

Nuclear engineer Raymond W. Klecker, University of Southern California, EE '49, is supervisor of design of nuclear reactors.

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TECHNIBRIEFS

THERMOCOMPRESSION BONDING MAKES TRANSISTORS RUGGED

Bell Telephone Company has announced a new system of attaching lead wires to the surfaces of germanium transistors.

In high-frequency transistors, small lead-in wires (.0004 inches in diameter) must often be attached to very small areas (.000006 square inches) on the germanium. In the new system of attaching the leads, the areas of the germanium to which the leads are to be attached are first treated with evaporated and alloyed metal films from fifteen hundred to three thousand angstroms thick. A combination of heat and pressure is then employed to form the bond. The pressure with which the lead wire is pressed into the transistor is held low enough that the germanium will not break, and the temperature cannot exceed the annealing range of the lead-in wire metal.

The same type of operation is also used when a large area of contact is desired. In this case, the lead wires are "headed" like nails to diameters of about .030 inches and are pressed into the gold plated contact surface of the semiconductor.

Thermocompression bonds can be made in a few seconds, and, even on small contact areas, the bond strength can be made to exceed the strength of the lead wire itself. Thermocompression bonds have withstood accelerations of as high as one hundred thousand times the acceleration of gravity. They will greatly increase the strength and shock resistance of transistor units in the future.

PURE HELIUM PRODUCED BY NEW DIFFUSION METHOD

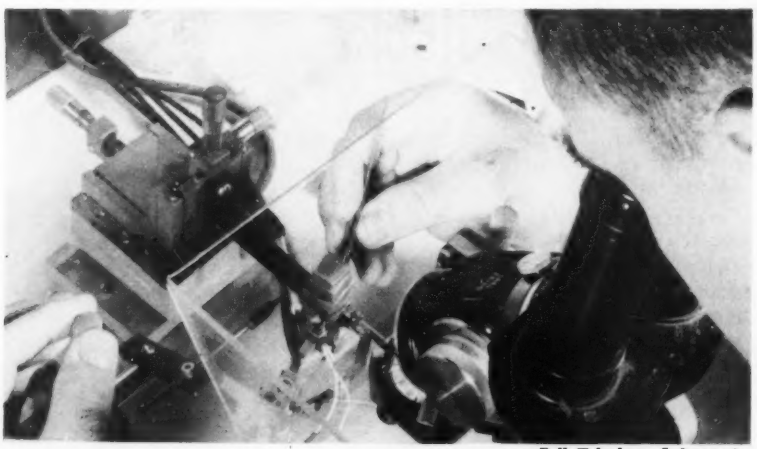
A new diffusion technique which will greatly increase helium production has been developed. The helium, containing only .0009 per cent hydrogen, is one of the purest gases available. This is particularly welcome since the demand for helium has risen much faster than the ability to produce it. It is also important because the greatest supplies of helium are mixed with other gases; the resulting mixture having, at best, only six or seven per cent helium. This diffusion method also greatly simplifies extracting helium.

The system depends upon the fact that silica glass has an extremely high permeability for helium—one thousand times as much as for hydrogen, the next most penetrating material. Also, this permeability is high enough to make this method practical for large quantities of gas.

However, in order to make this method practical, a large surface of the gas must be exposed, the glass must be very thin, and a high pressure differential must be maintained between the two sides of the glass. One of the best answers to this problem appeared to be a bundle of fine glass capillary tubing, arranged so that the gas, under high pressure, flows around the outside of the tubing and the helium is recovered through the inside of the tube. These units of tubes called "bundles" are so impervious to wear and damage that they may be placed directly in pipelines separating and purifying helium at its source.

Extremely important to this process are the properties of the glass tubing, which may be drawn so fine that it has an outside diameter of two mils and a wall thickness of two-tenths of a mil. It is also capable of withstanding pressures up to one thousand atmospheres and temperatures up to 400 degrees. This high strength at high temperatures is important since the diffusion of the gas rises sharply at high temperatures, being 100 times greater at 400 degrees Centigrade than at room temperature. During this operation, however, the concentration of hydrogen must be maintained at at least 1 per cent.

The results already obtained indicate that this process can be readily adapted to large scale commercial purification and high volume separation of helium.



Bell Telephone Laboratories

Tiny gold lead-in wires are being bonded to the surface of a high-frequency transistor by means of the newly developed process of compression bonding. By means of this process, leads can be connected to tiny areas on the transistor with extremely high bond strength.

'WHISKERED' ALLOY EXHIBITS ULTRA-HIGH STRENGTH

An ultra-high strength steel alloy having tensile strengths up to 400,000 pounds per square inch has been developed. For example, a one-eighth inch steel wire could support 5000 pounds!

This steel possesses its remarkable strength as a result of its fabrication. It is made up of thousands of single crystal wires known as "whiskers", whose maximum predicted tensile strength is in the vicinity of 1,000,000 pounds per square inch.

The steel compares favorably

with the modern titanium based alloys presently in use. Titanium alloys with tensile strengths of 190,000 to 240,000 pounds per square inch are a little more than half as heavy as steel. This steel having a tensile strength of from 340,000 to 430,000 pounds per square inch is presently able to compete with titanium alloys and is shortly expected to surpass its present performance.

Another important factor is the ductility at high strength which is characteristic of this new steel. Previously, metals having a tensile strength of over 300,000 pounds per square inch were notorious for their brittleness. This steel, however, is not only ductile; it maintains its high tensile strength and ductility at temperatures as low as —385 degrees Fahrenheit. Coupled with an extremely high fatigue limit of approximately 200,000 pounds per square inch, these qualities should lead to ready acceptance and widespread use in both industry and research projects.

Bell Telephone Company

Two employees of the Bell Telephone Co. study a helium diffusion tube consisting of a "bundle" of one and one half miles of capillary tubing. These "bundles" are the basis of the revolutionary helium diffusion method.

NEW DETECTOR SENSES INFRARED RADIATION

Scientists at the Westinghouse Research Laboratories have developed a new ultra-sensitive detector that can respond to less than one-twenty-billionth of a watt of infrared radiation.

The function of the infrared detector is to convert invisible infrared radiation into electrical signals that can be amplified and seen. It is the most critical component of a complete infrared system. These systems are assuming increasing importance in a variety of scientific and military tasks. They are used, for example, for guiding missiles to their targets, detecting missiles and aircraft, photographing heat patterns on the ground in the absence of light, and studying the radiation from stars and other celestial bodies.

Every object above the absolute zero temperature of outer space emits infrared radiation. It is generated inside the molecules of a material as a result of their own thermal motion. The higher the temperature, the faster the molecules move, and the more energetic and short in wavelength is the infrared emitted by a body.

Infrared lies in a band of wavelengths between those of visible light and microwave radar. For this reason, infrared sometimes behaves like light and sometimes like radar waves. Its practical applications serve many of the same functions as radar. Like light, it is reflected and refracted by mirrors and lenses, and the devices used to detect it resemble those useful for detecting light rays.

The new Westinghouse infrared detector is a type known as a "photoconductor detector." A photoconductor is a solid material that changes its ability to conduct electricity when radiations such as infrared or visible light strike its surface. As a result, changes in the intensity of infrared radiation reaching the photoconductor are converted into changes in the amount of electric current flowing through it.

The photoconductor in the new detector is composed of germanium, the basic semiconductor material from which most transistors are made. The germanium, however, is made sensitive to infrared by adding an impurity, gold. It is this new photoconducting material that gives the device its superior characteristics.

In addition to its sensitivity, a major advantage of the new detector is that it responds to low frequency infrared radiation. These lower frequencies correspond to low temperatures and are very difficult to detect. For example, it is not difficult to detect a red-hot object at 1500 degrees Fahrenheit with an infrared detector because the radiation is of comparatively high energy and short wavelength. It is not so easy, however, to detect infrared radiation from the same body at 100 degrees because the total emitted energy has dropped to less than one-hundredth its original value. The new detector is sensitive to infrared with wavelengths as long as 10 microns which would correspond roughly to room temperature.

The new detector responds very quickly to changes in radiation so that rapid fluctuations in the temperature of a body may be sensed. Since the sensitivity and frequency response of a photoconductive infrared conductor is increased by operating it at low temperatures, the detector is cooled to a temperature of 320 degrees below zero Fahrenheit by surrounding it with liquid nitrogen in a special container.

The new infrared detector has proved so successful in its experimental development that plans are under way for its early production. Because of its fast response and high sensitivity to a wide frequency

range, it is believed that the detector will increase the performance of infrared systems and will open up new applications for infrared in industry.

NEW ALLOY CUTS WEIGHT OF MISSILE COMPONENTS

A new stainless steel alloy has enabled engineers to reduce the weight of the fuel tank and camera pod sections of a new missile by 50 per cent.

This missile, the new X-7 recently tested at the Air Force Missile Development Center, Alamogordo, N.M., holds both the speed and altitude records for United States air breathing missiles. The missile is primarily employed to flight test certain components, such as ramjet engines, for the Air Force.

The X-7 was designed to meet the rigid flight testing requirements for the newest and most powerful ramjets. Although capable of either air or ground launching, it is presently being launched from the bomb bay of a B-50, miles above its home base at Alamogordo. The required acceleration to supersonic speeds is provided by external booster rockets mounted under the wing.

The weight reduction in the 108 gallon fuel tank and the five foot camera pod came as the result of a new high strength steel alloy, known as AM 350, developed by the Allegheny Ludlum Steel Corporation. The great strength of this metal permitted engineers to decrease skin thickness to 1/32 of an inch. This metal also found favor with the engineers because of its corrosion resistance, good fabricating qualities, fatigue resistance, and high strength to weight ratio at high temperatures.

The missile, guided in flight by ground technicians, relays a continuous stream of vital information to earthbound scientists.

NUCLEAR REACTORS CONTROLLED BY VARIABLE DENSITY WATER

The Babcock and Wilcox Company has proposed a new approach to raising the efficiency of nuclear reactors. Inefficient use of fuel and high equipment costs have thus far prevented the atom from competing with conventional power sources.

Mixed "light" and "heavy" water is used to control pressurized and boiling water reactors, replacing the costly and intricate control rod systems now widely employed. It is estimated that this new control method will more than double the useful life of a water reactor core and increase the efficiency of fuel consumption up to 30 per cent. Also, equipment costs will be reduced since it will be possible to extract up to 75 per cent more heat from a core of a given size.

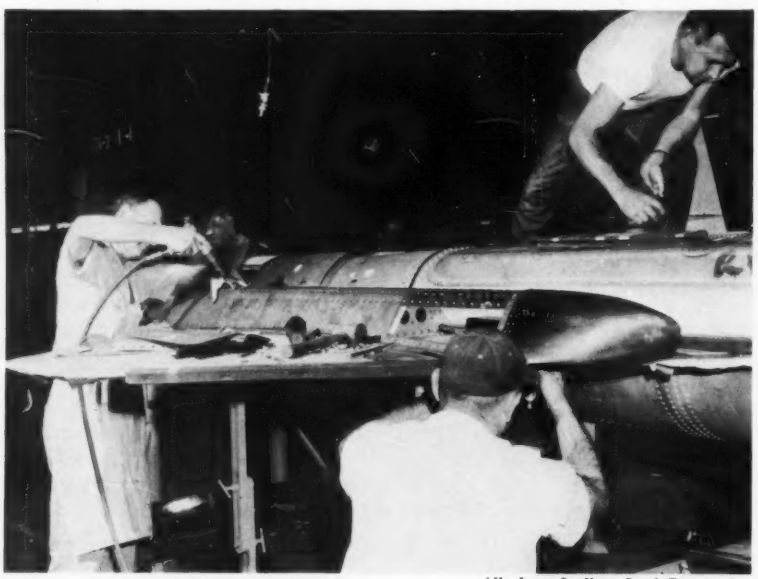
In order for a core to have a long life span, it must be loaded with considerably more fuel than is actually required to achieve a chain reaction. This extra fuel is then available to be "burned" to produce heat, power, or both. When burnup has reduced the amount of fuel in the core to the minimum required for a chain reaction, the core can no longer produce heat and must be replaced.

The fuel placed in the core for burnup is used up less efficiently if control rods are employed to counteract the "reactivity effects" of the extra fuel. The new method provides a positive control medium which not only promises to achieve a low fuel burnup rate for the amount of heat produced, but also permits larger amounts of extra fuel to be added to nuclear cores. This makes possible a longer-burning and more efficient reactor fuel cycle.

DC CURRENT PREVENTS BOAT HULL CORROSION

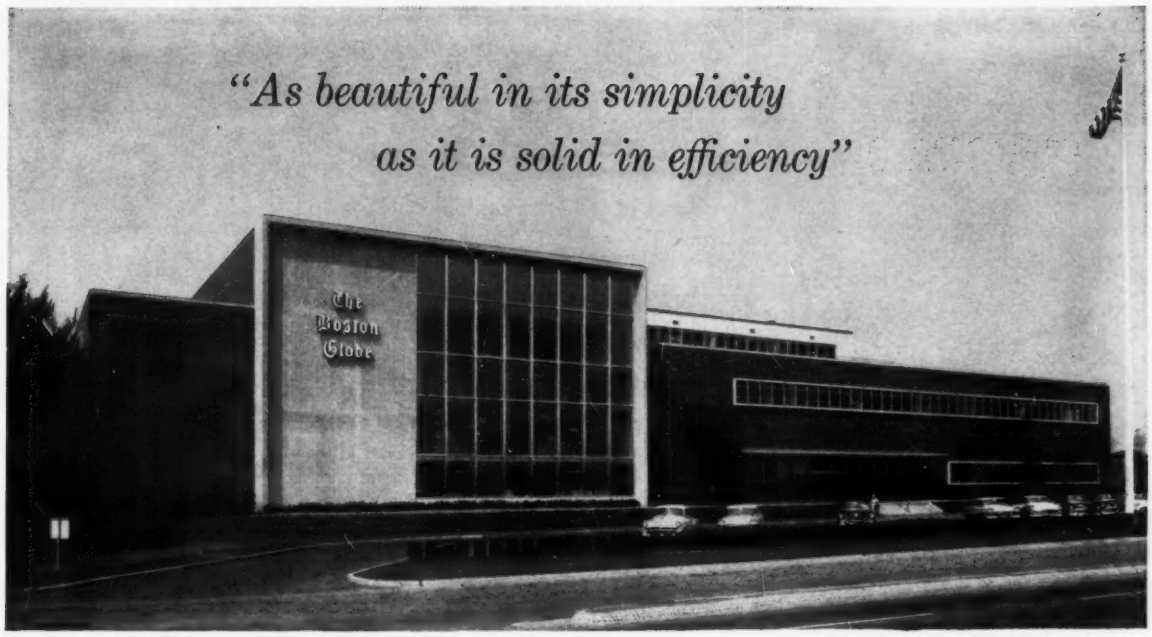
A new type of corrosion-prevention system for small boats developed by the International Nickel Company and Charles Engelhard, Inc. is now being demonstrated on a small cruiser named the "Platanode." The new system for small pleasure craft is a scaled down version of the system used on several Navy ships.

The system employs a platinum anode mounted in the hull. A controlled current flows from the platinum through the sea water to the metal hull. The current flow in this direction prevents any rusting action to the hull. One difficulty encountered on previous systems was that with a current flowing from the anode, the anode became very susceptible to oxidation. However, the platinum metal is sufficiently inert that the low voltage used by the system is not sufficient to make it oxidize. The relatively small current needed for the system is supplied on the "Platanode" by a nickel-cadmium battery which can operate the system on an idle boat for three months. Provision is also made for hooking the system to a permanent dock power supply. Resistors allow control of the voltage for varying conditions and the voltage automatically increases when the boat is moving.



Allegheny Ludlum Steel Corporation

Workmen put the finishing touches on the camera pod section of a Lockheed X-7 missile. The new steel alloy, AM 350 permits a saving of 50 per cent in the weight of the assembly since the shell is now only half as thick as it was with the metal formerly used.



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New Boston Globe Building relies on JENKINS VALVES

When the Boston Globe moved into this modern newspaper plant, it *made* news. A showplace for passersby with its battery of 37 presses turning out the news in a "picture window" two stories high, the new $12,000,000 home of the 86-year-old Globe is a model of efficient operation.

Efficiency is seen throughout the building plan. For example, practically all mechanical departments are on the first floor. The stress on efficient, trouble-free operation is equally evident in the equipment specifications which provided for utmost dependability in everything mechanical. To assure complete dependability in the control of water, air, gas, heating and air conditioning lines, Jenkins Valves were chosen.

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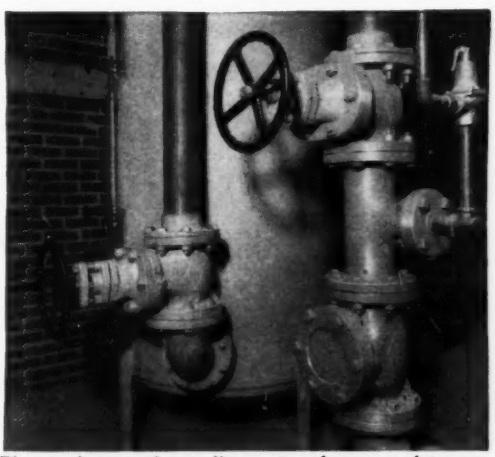

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Faculty Profile . . .

PROFESSOR BART J. CONTA

by

David S. Kessler, ME '62

Peter Gaalaas

Professor B. J. Conta

Few professors, indeed, have as unique an approach to their course matter and students as does Professor Bart J. Conta. Lauded by students and faculty alike, Prof. Conta has been teaching at Cornell since 1937, except for a four-year stint at Syracuse University and a two-year period of employment by the Texas Co.

Born and raised in Rochester, Prof. Conta received his B.M.E. from the University of Rochester in 1936. He came to Cornell in the fall of 1936 and the following year, after having completed the requirements for his M.S., Prof. Conta began teaching as an instructor of materials testing and metallurgy.

Prof. Conta left Cornell in 1940 to work for the Texas Company. After two years he decided he wanted to go back to school. The joint efforts of Professors Berry of Harvard and Ellenwood of Cornell brought him back here in 1942. During the war years he served in the very important position of instructor in both the Navy Diesel School for Midshipmen and in the Navy Steam School. In 1947, Prof. Conta again left Cornell; this time he went to Syracuse University where he taught in the College of Applied Science before returning here in 1951. He has been teaching courses in thermodynamics, gas turbines, internal combustion engines and other related courses since then.

In regard to his students Prof. Conta said, "Cornell students are remarkably able and we are fortunate to get this calibre of student at Cornell. But the Cornell student does not seem to be as well motivated for technical study as students at some other engineering schools. This results, of course, from the interest of the Cornell student in social and extra-curricular pursuits as well as in his academic work." Even though there are many people who feel this is a disadvantage, Prof. Conta looks upon it as a healthy thing. Many engineering graduates assume managerial positions in which a social background such as that achieved at Cornell will aid them in administering their duties.

However, Prof. Conta does try to stimulate his students by presenting to them many unusual problems. In fact, he jokingly admits, he is infamous for one particular thermodynamics problem. "Find the change in entropy of a watch while it is being wound and run down." He feels that an engineer besides getting professional training should also get an education. By giving his students unusual problems, Prof. Conta is trying to give them an intellectual challenge in addition to their professional training.

In his genial, soft-spoken manner, Prof. Conta described his family. He and his wife have two daughters, one a senior at Ithaca High School, and a son who attends the University of Rochester. His wife is a member of the garden club and is an amateur interior decorator. The favorite pastime of both Prof. and Mrs. Conta is going to auctions. They are avid collectors of antiques and have refinished most of their furniture.

Last year, Prof. Conta, accompanied by Mrs. Conta and their two daughters, spent his sabbatical leave at the Wilmington, Delaware home of E. I. du Pont de Nemours and Co. In Du Pont's widely diversified engineering department, he had the opportunity to see first hand what industry really expects of the engineers that the colleges help train. "The specific contact with an engineering service in my field wasn't why I accepted the invitation to join Du Pont for a year though," Prof. Conta told me. "If that's all I had wanted, I could have gone to work for a power company. Instead, at Du Pont I saw how people practice engineering in other fields. This insight is going to help me in my teaching."

Prof. Conta's latest project is helping fourteen fifth year M.E.'s with their work on solar energy. But, for Prof. Conta, the job he most enjoys, one that goes on continuously, is that of making his courses interesting and intellectually stimulating for his students.

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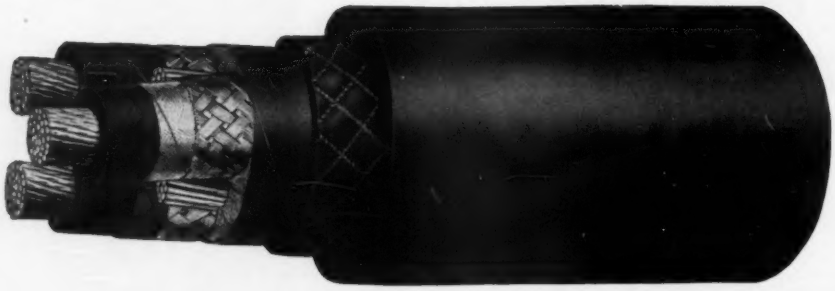

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James E. Beehler (Purdue, MSEE '48), Frank W. Clover (Carnegie Tech, BSEE '47; Harvard, MA '51), Richard E. Disbrow (Lehigh, BSEE '52), plan the AEP System of the future with a network analyzer.

3. New York City—STAFF ENGINEERS
Richard H. Pechstein (RPI, BME '46) and John E. Dolan (Columbia, BSME '50) perform heat balance calculations on new steam cycle.

4. Wheeling, W. Va.—DISTRIBUTION ENGINEERING
Enea Antonucci (West Virginia, AB, BSEE '54) and Robert O. Meador (Tri-State, BSEE '49) supervise installation of underground distribution facilities.

5. New York City—NUCLEAR POWER ENGINEERS
John R. Struyk (Clarkson, BME '51) and Robert S. Hunter (Penn State, BSME '50) discuss design of fuel element.

6. New York City—APPLYING DIGITAL COMPUTERS
Howard K. Amchin (Penn State, BSEE, '46; IIT, MSEE '49) and Glenn Stagg (MIT, BSEE '48; NYU, MBA '56) selected by Eta Kappa Nu as one of three outstanding young engineers in the U. S. in 1958, solve a special problem faced by the AEP System.

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Robey Jarrett (VPI, BSEE '51) consults with contractor on progress of motel to be heated and cooled electrically.

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Richard P. Blaes (Dayton, BEE, '51) helps to coordinate load scheduling and exchange of power with other electric utilities.

9. Twin Branch, Indiana—POWER PLANT MAINTENANCE SUPERVISOR
Herbert A. Bissinger (Michigan College of Mining and Technology, BSEE '50) leads briefing session concerning turbine overhaul schedule.

10. East Liverpool, Ohio—DISTRICT MANAGER
William A. Black (MIT, SMEE '50) discusses operating problem with the supervisors on his staff.

11. New York City—RESULTS ANALYSIS
Engineering trainee Paul Butler (Purdue, BSME '58) discusses features of recording instrument with steam generation engineer Richard C. Kopelow (Michigan, BSME '51).

12. New Haven, West Virginia—RESULTS ENGINEER
William R. Johnston (Univ. of Cincinnati, BSME '51) analyzes circuit for electronic instruments at a major power plant.

13. Muncie, Indiana—DIVISION METER SUPERVISOR
Jack Stark (Purdue, BSEE '49) examines the demand chart on a metering device for an industrial customer.

14. New York City—HIGH VOLTAGE RESEARCH
Jack M. Miller (Milwaukee, BSEE '57) and Robert H. Schlomann (MIT, SMEE '56) discuss means for reducing radio influence on 345 kv transmission lines.

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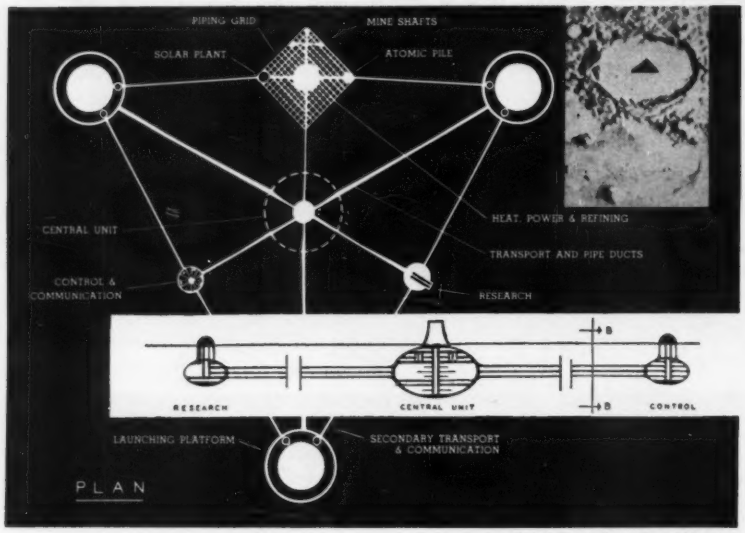

SCALE OF PLAN: 1" = 500 FT.

lunar base

Tomorrow's realities depend on research and imagination today. Both were used extensively in the planning of this lunar base designed by William G. Harvey, Jr. to accommodate space ships and travelers. The suggested location is "Aristotle," one of the craters near the north pole of the moon. Most of the base is beneath ground level to minimize temperature changes. Living quarters are spacious and recreational facilities include a swimming pool and basketball court. Power is supplied by solar plants during the day and atomic pile at night. Research, living and working areas are joined by monorail subway.

No one can be sure which of today's new ideas will become reality tomorrow. But it will be important then, as it is now, to use the best of tools when pencil and paper translate a dream into a project. And then, as now, there will be no finer tool than Mars—from sketch to working drawing.

Mars has long been the standard of professionals. To the famous line of Mars-Technico push-button holders and leads, Mars-Lumograph pencils, and Tradition-Aquarell painting pencils, have recently been added these new products: the Mars Pocket-Technico for field use; the efficient Mars lead sharpener and "Draftsman's" Pencil Sharpener with the adjustable point-length feature; and—last but not least—the Mars-Lumochrom, the new colored *drafting* pencil which offers revolutionary drafting advantages. The fact that it blueprints perfectly is just one of its many important features.

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ALUMNI ENGINEERS

(Continued from Page 33)

100th birthday June 22. He is the second oldest living Cornellian. Mr. Marx became general sales manager of the Gray Co. in 1889 and was president from 1905–52. He was one of a small group of engineers, including Thomas A. Edison and Ambrose Swasey, who founded the American Society of Mechanical Engineers in 1880.

COSMIC RAYS

(Continued from Page 23)

emission, still remains theoretically nebulus and unquantified. However, these electromagnetic phenomena may gain investigative prominence in the near future if their potentially represented communication hazards materialize.

These galactic barriers to manned space travel are being intensively investigated to obtain more exact quantitative information. Meanwhile, the problem of countermeasures has already been approached by missile designers. Upon the successful solution of these investigations, hinge our early explorations into space.

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BALLOONS

(Continued from Page 17)

chine guns were mounted on their hulls. Some were even equipped with cabins, which could be lowered beneath the clouds for navigation and observation while the ship remained hidden above. These craft were especially formidable, for they could climb high out of range of fighter planes and anti-aircraft guns. Whole fleets of them besieged London.

At the close of the war those ships which had survived were taken by the Allies and dispersed to their several countries. German production was strictly limited. The United States received the LZ 126 as a war indemnity in 1924 which was renamed the *Los Angeles* and used by the Navy for nine years before retirement. In 1928, after commercial air service had been restored to Germany, the LZ 127, the *Graf Zeppelin*, under the command of Dr. Hugo Eckener, captured wide acclaim by flying around the world. The journey took twenty-one days.

Soon an even larger ship, nearly three blocks long, using over seven million cubic feet of hydrogen, was constructed with an eye toward increasing regular transoceanic passenger service. This last of the great ships was the *Hindenberg*. Though the lifting gas was known to be highly inflammable, it was used because helium, though safer, was so difficult to obtain. The United States had most of the world supply.

The *Hindenberg* flew the Atlantic for more than a year. It was inexpensive to operate, as easy to steer as an automobile, and far safer. In the twenty-eight years of dirigible commercial passenger service there had been no fatalities. Then in May, 1937, a few moments before mooring at Lakehurst, in the presence of a mob of spectators, the *Hindenberg* flashed into flames and was destroyed in a matter of minutes. The disaster occurred during a severe thunderstorm, and it is thought that static electricity around the mooring mast ignited a hydrogen leak in the hull.

Although plans had been initiated for a still larger airship, using helium imported from the United States, the fear of war halted its construction, and the age of the airship came to an end. Within a few years the new ship and the *Graf Zeppelin* were scrapped, and the aluminum used for German fighter planes.

Balloons Probe Upper Air

Meanwhile, the spherical balloon was being used by scientists to probe the upper air. There is in the upper reaches of the atmosphere a marked point where the temperature ceases to fall, or even increases slightly with the altitude. This, from the meteorological point of view, is the stratosphere, where the condensation of water and the formation of clouds no longer takes place. The lower limit of the stratosphere begins on the average at 7.5 miles. By 1930, tests had been made by sounding balloons, but because of the rarification of the atmosphere, man himself had not ascended.

At that time, the measurement of cosmic rays by automatic instruments had not been perfected. Therefore, Auguste Piccard, a Swiss physicist, decided to ascend into the stratosphere. Piccard had the secondary objective of convincing the air services to use the high atmosphere for travel at high speeds, because the rarified air offered less resistance. Piccard designed a hermetically sealed gondola of sheet aluminum, seven feet in diameter with eight small portholes. For ballast, he used a very fine lead shot. In his book, *Earth, Sky and Sea*, he tells of how he tested the ballast for safety to spectators. "I made sure myself that there was no danger, by standing at the bottom of the big chimney of the University of Brussels under a rain of shot which was poured on my head from a height of 165 feet."

In May, 1931, Piccard and his colleague Paul Kipfer ascended from Berne, Switzerland, and rose 51,793 feet, thus penetrating into the stratosphere. They described the sky as, "The most poignant thing we have seen: it is sombre, dark blue or violet, almost black. If the air were perfectly transparent, we should see the earth over a radius of 280 miles, and our visual field would cover 246,000 square miles of the planet (more than the surface of all France). But beneath the stratosphere there is the troposphere, whose upper limit on that day was about 7.5 miles: it is much less transparent. . . . But, even if we look vertically down, the picture is blurred as in a bad photograph. There is, in fact, between us and the earth nine-tenths of the atmosphere, almost as much as if, at sea-level, we were looking at the moon."

One side of the cabin had been painted black and the other left bright. The black was intended to reduce heat from solar radiation, but the rotation motor had been damaged and the temperature in the cabin rose above 100°. The flight was made more precarious because the excess gas valve failed to operate. Nevertheless, the aeronauts landed safely. In subsequent separate flights Piccard and his twin brother Jean ascended more than ten miles gathering important information on cosmic rays.

Shortly thereafter, work was begun on several larger stratosphere balloons: three in the United States, two in Russia, and one in Poland. They were constructed of a rubberized fabric inflated with hydrogen. The first American venture of the stratosphere balloon the *Explorer I* failed, because, though the fabric had been properly tested to withstand normal stress, adhesions had developed during the long storage period while awaiting suitable flight weather. As the gas expanded in flight, the bag tore, and the resulting hydrogen-air mixture exploded, disintegrating the balloon in midair. The Army launched *Explorer II* on Armistice Day 1935. This second balloon, inflated with helium, supported in a nine foot gondola an airborne laboratory containing cosmic ray apparatus and equipment for testing ozone and the composition of the stratosphere. The flight was a success, and a new altitude record for

manned flight of 72,395 feet was attained.

Synthetic Films Replace Fabric

Today polyethylene and Mylar polyester have replaced rubberized fabrics and other relatively heavy materials in an entirely new concept of balloon construction. The fabric of *Explorer II* weighed 6,500 pounds, while the comparably-sized envelope of the recent *Super Skyhook I*, made of polyethylene film, weighed only 850 pounds.

The new plastics are not only lighter, but are much less expensive. Plastic sheeting costs about four cents per square yard as compared with two dollars per yard for the rubberized cotton. Then too, the heat sealing process can be semi-automatic, while the cotton fabric had to be hand cemented. The film, ranging in thickness from .0005 to .0025 inches, is the same type as that used for packaging modern grocery products. One of the foremost contractors for these new balloons, General Mills in Minneapolis, after extensive research turned to polyethylene film, because it is chemically stable, holds gas, and is relatively unaffected by temperature changes. Their largest balloons may use up to four acres of film. The gores of the balloon are cut to size on special work tables up to 350 feet long. Their seams are sealed together by a jet of hot air forced through a nozzle and then reinforced with polyethylene tape. Even more recently, successful experiments with Mylar polyester film have been initiated. Mylar is only about one-fourth as thick as polyethylene and weighs only about one-fifth as much.

Balloons Are Vital To Science

The free balloon remains the silent, peaceful servant of mankind. For some time, smaller ones have been carrying messages to countries behind the Iron Curtain. The Navy now regularly employs fleets of balloons to study wind, temperature, and air currents. One Navy balloon made the 10,000 mile flight from Japan to Jackson, Mississippi in three days, reaching a top speed of 200 m.p.h. when caught by the high altitude jet stream.

This October for the first time a balloon carrying a light high-frequency transmitter was dropped into the eye of a hurricane. The inner winds carried the balloon along for nearly twenty-four hours, while the transmitter signaled to observers an accurate course of the storm.

In the fall of 1957, several hundred photographs of the sun's surface were taken by a specially constructed telescope-camera system for Project Stratoscope. The project dealt with the graininess of the sun's surface which is not observable through the earth's atmosphere. The balloon carried the instrument approximately 90,000 feet above the surface of the earth. The instruments were recovered after being lowered to earth by a parachute. Normally the whole balloon system never returns to the earth, for when the gondola is suddenly released by means of a timer or radio control, the balloon shatters into thousands of pieces due to the shock imparted to the plastic film at very low temperature. A flight control and telemetry center collects the data sent out by the balloon transmitters. On many flights certain characteristics are controlled by transmitting coded signals to the balloon. The center also coordinates the activities of aircraft which track the flight of the balloons and of ground recovery vehicles, so that the instruments may be quickly recovered upon landing.

Last winter the USAF launched a *Farside* rocket from Eniwetok Atoll in the Pacific. The rocket was carried 80,000 feet up and launched through a balloon so that it would not have to expend a great amount of energy in penetrating the earth's atmosphere. Some components of the subsequent rocket flight were estimated to have gone up 4,000 miles, with a top speed of 17,000 m.p.h. at the fourth and final stage of propulsion.

Although rockets can reach higher altitudes than balloons, their great speed and relatively short flight limit their usefulness in obtaining certain forms of cosmic information.

Despite the use of automatic scientific instruments, the era of the aeronaut or "balloonatic" continues. For until a manned satellite is perfected, the balloon remains the best vehicle from which to make solar observations.

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Here, your "feel" for space will come quickly. Vought's core of seasoned space specialists is introducing the new medium to a widening circle of colleagues. The goal is space indoctrination for all engineers – a space capability comparable to Vought's current stature in missiles and aircraft.

With experience, the young engineer will join Vought projects under way this minute: space research vehicles; cockpits and crew quarters for space; devices for escape from orbit; nuclear and ionic propulsion.

In astronautics, as in *Crusader III* fighter and *Regulus II* missile development, the Vought engineer's view will be broad. He will conceive, develop, design and test complete products. This is an advantage found only in a company that holds both weapon system management and detail design responsibility.

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

Chance Vought's Regulus II. Nuclear-armed, long-range missile. First supersonic missile ever successfully launched from a submarine.

FIFTY YEARS AGO

(Continued from Page 30)

a practically continuous sheet of air underneath the craft.

The writer believes that a reasonable increase in speed can be brought about by the use of this method.—(*The Sibley Journal of Engineering*, October 1908.)

Last year the opening of the first floor of Sibley Dome to all students as a smoking, reading, and lounging room did much towards fostering social intercourse. The piano should seldom be silent between classes. What is also encouraging is the interest being taken in the Student Branch of the A.I.E.E. and in the Sibley Engineering Club. But the social side of these meetings should be still further enlarged. Let the keynote be good fellowship and general social intercourse among students and professors, and we feel that as much if not more benefit will be derived, as from lectures of too technical nature. Sufficient opportunity for the latter is supplied in the class room; more men will be appealed to by social meetings than by meetings which they are afraid will be uninteresting to them.—(*The Sibley Journal of Engineering*, November, 1908)

A great deal of interest has been shown in inter-college athletics this fall. Last June Dean Haskell, Professor Barnes, and L. Kampf, '09, were named as a committee to take charge of the work this year in athletics, and things are going in fine shape.

For the first time soccer football takes its place as a sport for the civil engineer. Nearly every day can be seen a notice like this: "Line up for Soccer this afternoon at 4:30 on the playground" and the signs have an effect, for toward evening may be seen quite a group kicking the ball around, getting gym credit, exercise, and lots of fun.

The first game was lost to the Agricultural College by a score of 2 to 1. The second game was won from the Veterinary College by a score of 1 to 0. The third game was won from the Arts College by a score of 3 to 0.

Later in the year the colleges compete in cross-country, basketball, track, and crew. There is now no excuse for a man not being an athlete of some sort or another.—(*The Cornell Civil Engineer*, November, 1908)

We are in receipt of a sample of Edge's Weight Computor, a device with which the weights of all kinds of structural shapes can be calculated rapidly and accurately. This machine consists of two discs, one rotating about the other, each disc being marked with logarithmic scales representing the dimensions in feet and inches of the various shapes, and the result in pounds. The accuracy of the machine is about one-third of one per cent, more accurate than is necessary for all estimating work. (*The Sibley Journal of Engineering*, December, 1908)

For some years past the method of registration in this College has been a matter of much thought on the part of the student body. Guesses, opinions, and, in extreme cases, even wagers have been offered as to what method would be tried next, and in nine cases out of ten when the final results appeared it was found to be even more weird, round about, fanciful, and heartbreaking than the wildest imagination among the ones the students had conjured up. At last, however, we are approaching the millennium. It is no longer necessary for the student to spend two days a year tramping and being tramped on. Last September the more fortunate ones passed through the ordeal in but little more than half a day —including the college stamp, the assignments and arrangements, and finally the recording of the assignments and arrangements. And still better and more wonderful: when that had been accomplished, if the individual had used his head as well as his mouth, he was practically registered in the college for the year, not for the term as heretofore. For the man who had "doped" it all out properly, found that he had but to secure the college stamp, and leave a segment of the "accordian slip of registration" at the college at the beginning of the second term in order to be through the mill again. Even this might be done by proxy, so that the men suffering from the Junior Prom disease of the night before might lie a-bed and dream of the sorrows of registration of the past years. We appreciate our advantages over the Sibley man who has to register in person, and pass through the entire scrimmage twice, and we render thanks where they are due for our blessings.—(*The Cornell Civil Engineer*, February, 1908)

LETTERS TO THE EDITOR

(Continued from Page 6)

this physical power largely of their own making is properly used. Social wisdom has not kept pace with material progress but the two must be brought in proper balance. In this effort, the five year courses should do much to turn out engineers with broad cultural sympathy and intellectual understanding. This is the quality of engineer the world demands and of which there is a definite shortage.

Charles Weiss, CE '13

To the Editor:

I wish simply to repeat the message I sent your office several years ago: the thanks of the students and faculty of The Thacher School for your continuing gift to our Library of the CORNELL ENGINEER.

Through the years, this periodical has had very frequent use; and with growing awareness of scientific topics and studies, I have watched its ever-increasing importance in our library collection. We have carefully kept past issues on file, and I maintain a notebook-index of the magazine articles to facilitate its use for special assignments. (I wish you were indexed in *Reader's Guide!*)

Thacher School is working on arrangements for a summer-school session in physics and mathematics in 1959 for a group of boys who will qualify through competitive examinations in a large area of southern California. Our file of CORNELL ENGINEER will be particularly valued during that course, also.

Martha Lavender,
Librarian, Thacher School,
Ojai, California

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MEENY MINY

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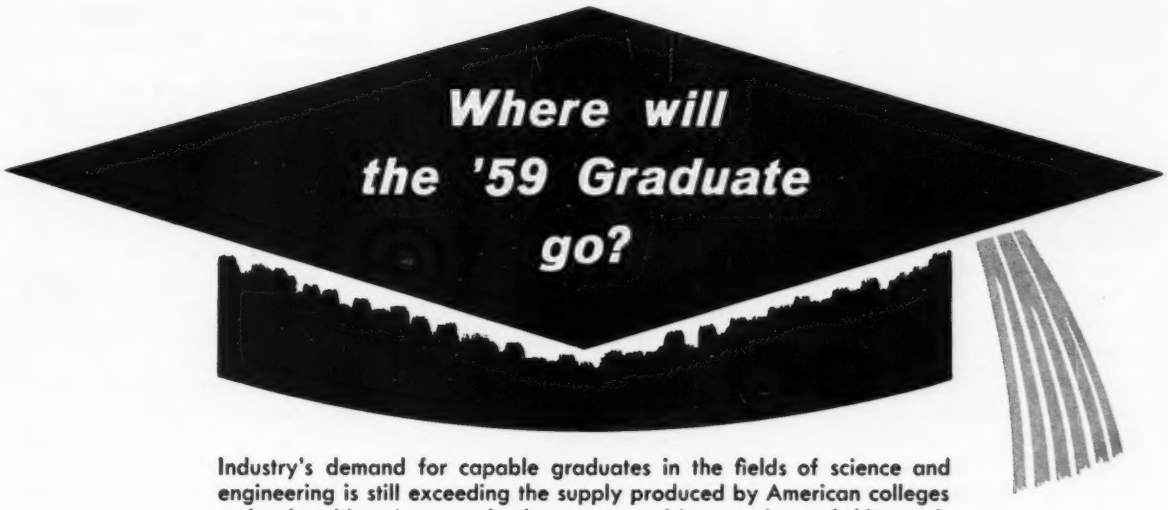

Industry's demand for capable graduates in the fields of science and engineering is still exceeding the supply produced by American colleges and universities. As a result, the most promising members of this year's class may well wind up with a *number* of openings to consider.

In such circumstances, who would blame a bright young man for at least letting the phrase "eeny, meeny, miny, mo" slip through his mind!

Of course, there is one inescapable conclusion to be considered: openings are one thing, genuine opportunities quite another. Thoughtful examination of such factors as potential growth, challenge, advancement policy, facilities, degree of self-direction, permanence, and benefits often indicates that real opportunity does not yet grow on trees.

Moreover, the great majority of personal success stories are still being written by those who win positions with the most successful companies.

For factual and detailed information about careers with the world's pioneer helicopter manufacturer, please write to Mr. Richard L. Auten, Personnel Department.

SIKORSKY AIRCRAFT

One of the Divisions of United Aircraft Corporation

Bridgeport-Stratford, Connecticut

STRESS *and* STRAIN...

1st. M.E.: "You cutting machine design Friday?"

2nd M.E.: "Nope, I can't. Need the sleep."

• • •

Doris: "I can't marry John, father. He's an atheist and doesn't believe there's a Hell."

Father: "Go ahead and marry him, Doris, you'll convince him."

• • •

Professor: "What are the bones in your hand called?"

Med. Student: "Dice."

• • •

First Dog: "Do you have a family tree?"

Second Dog: "No, we're not particular."

• • •

What They Mean When They Say:

See me after class—(it has slipped my mind).

Pop Quiz—(I forgot my lecture notes).

I will derive—(formula has slipped my mind).

Closed book quiz—(Memorize everything including the footnotes).

Open book quiz—(Oil your slide rules and wind your watch).

Honor system—(alternate seats).

Do odd numbered problems—(the even numbered problems will be on test).

Briefly explain—(not less than 1000 words).

• • •

The British barmaid was a flirt, and when the corporal went out to buy a paper she pursed her lips invitingly and leaned over the bar towards the shy young private.

Putting her face against his, she whispered: "Now's your chance, darling." The private looked around the empty room. "So it is," he remarked, and promptly drank the corporal's beer.

• • •

A sign in a local store read as follows: "Our lingerie is the finest. Smart women wear nothing else."

Irate father: Why were you kissing my daughter in that dark corner last night?

Dubious youth: Now that I've seen her in the daylight I sort of wonder myself.

• • •

"How much is four times twelve, Jimmy?" asked the teacher.

"Forty Eight," replied Jimmy.

"Correct, that's very good," approved the teacher.

"Good, hell, that's perfect," exploded Jimmy.

• • •

A Scotsman and an Irishman were on board a ship bound for Scotland.

The Scotsman on catching sight of homeland exclaimed, "Hurrah for Scotland."

The Irishman, a bit riled, replied, "Hurrah, Hell."

Scotsman: "That's right, every man for his own country."

• • •

"Hello, Honey, I could hardly wait to tell you what's happened . . . Dad's cut off my allowance, I had to sell my car and drop my fraternity, but can still have fun just . . . Hello? . . . Ann? . . . Hello . . ."

• • •

A young man and date pulled over to the side of the road.

She: "You're not going to pull that "out of gas' routine, are you?"

He: "Naw, I use the 'hereafter' routine."

She: "The 'hereafter' routine?"

He: "If you're not here after what I'm here after, then you'll be here after I'm gone."

• • •

"Halt! Who goes there?"
"British soldiers."
"Pass British soldiers."
"Halt! Who goes there?"
"French soldiers."
"Pass French soldiers."
"Halt! Who goes there?"
"Who in hell wants to know?"
"Pass, Yanks."

Counselor: "How do you like this room as a whole?"

Freshman: "As a hole it is fine; as a room, not so good."

• • •

A radio announcer and his family were invited out to dinner. The hostess asked the announcer's young daughter to say grace.

The child cleared her throat, gave a quick glance at the clock and said.

"This food, friends, is coming to you through the courtesy of Almighty God."

• • •

A Texas oil man was visiting New York. His city friend showed him all of the sights including the Empire State building.

"Isn't that a magnificent structure?" asked his friend.

"Nothin," said the Texan. "I got an outhouse bigger'n that.

The New Yorker looked him over. "You need it!" he retorted.

• • •

They say that girls are minors until they are 18; then they are gold-diggers.

• • •

If young girls stay out late, drink, smoke and pet, men will call them fast—as fast as they can get to a phone.

• • •

Co-ed: Jack, are you sure that it's me that you're in love with and not my clothes?"

Jack: "Test me, darling."

• • •

There are only two kinds of parking left on the campus—illegal and no.

• • •

"What steps would you take in determining the height of a building using an aneroid barometer?" read a question in a C. E. exam.

One student replied: "I would lower the barometer on a string from the roof and then measure the string."

PHOTOGRAPHY AT WORK
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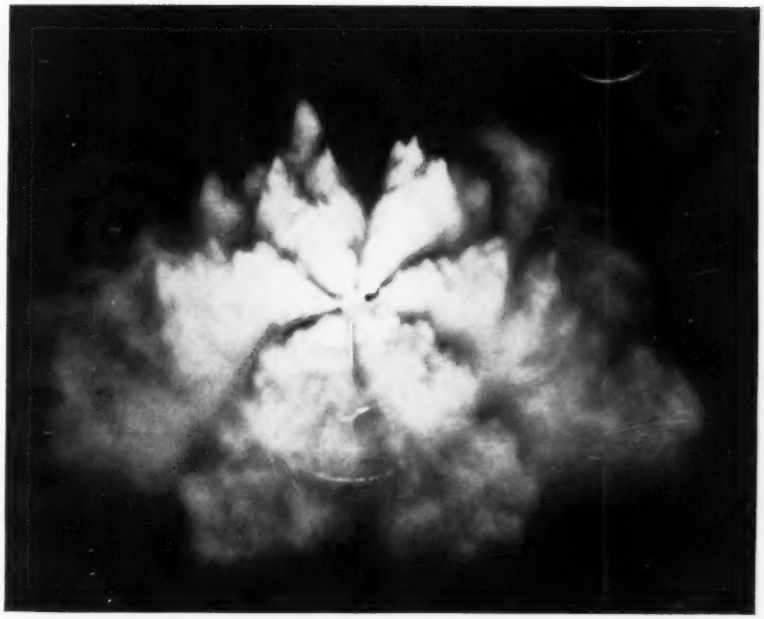
The Army's first operational rotor-tip propelled jet helicopter—built by Hiller.



The camera has caught the fuel spray pattern within the rear end of the ram-jet engine even though passing by at about 450 miles per hour.

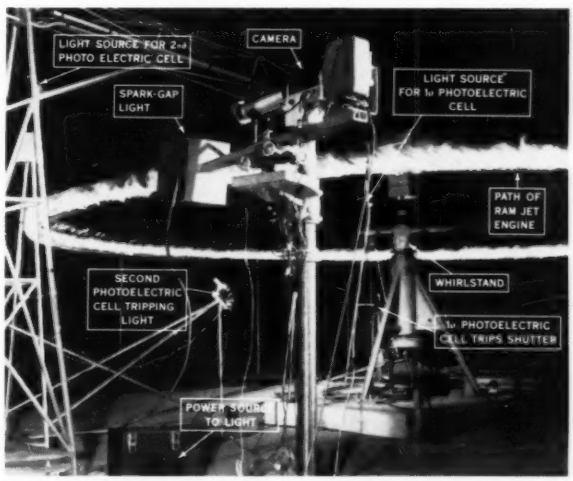
Project:
Inspect rotor tip jets for a whirlybird

Hiller Helicopters wanted facts on the fuel spray pattern of a ram-jet engine whirling at speeds up to 700 feet per second. Photography got the job.

WHEN HILLER HELICOPTERS of Palo Alto, Cal.—a pioneer in vertical take-off aircraft—developed a rotor-tip ram-jet engine, they knew the fuel spray would be subject to high air velocity and centrifugal force up to 1200 G's. Would the fuel spray be deflected outward and cause the jet to lose thrust? They wanted to know. So they set up the camera with its fast eye to catch what otherwise couldn't be seen. And they learned the right angle of air intake and nozzle to obtain the greatest power.

Using photography in research is an old story with Hiller—just as familiar as using it for improving public relations. It's an example of the way photography plays many important roles in modern-day industry.

In whatever work you do you will find that photography will play a part in improving products, aiding quality control and increasing sales.


LIGHT SOURCE FOR 2nd PHOTO ELECTRIC CELL
CAMERA
SPARK-GAP LIGHT
LIGHT SOURCE FOR 1st PHOTOELECTRIC CELL
PATH OF RAM JET ENGINE
SECOND PHOTOELECTRIC CELL TRIPPING LIGHT
WHIRLSTAND
1st PHOTOELECTRIC CELL TRIPS SHUTTER
POWER SOURCE TO LIGHT

This is all the human eye could have seen of the whirling ram-jet engine as camera takes its picture.

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Interview with General Electric's
W. Scott Hill
Manager—Engineering Recruiting

Qualities I Look For When Recruiting Engineers

Q. Mr. Hill, what can I do to get the most out of my job interviews?

A. You know, we have the same question. I would recommend that you have some information on what the company does and why you believe you have a contribution to make. Looking over company information in your placement office is helpful. Have in mind some of the things you would like to ask and try to anticipate questions that may refer to your specific interests.

Q. What information do you try to get during your interviews?

A. This is where we must fill in between the lines of the personnel forms. I try to find out why particular study programs have been followed, in order to learn basic motivations. I also try to find particular abilities in fields of science, or mathematics, or alternatively in the more practical courses, since these might not be apparent from personnel records. Throughout the interview we try to judge clarity of thinking since this also gives us some indication of ability and ultimate progress. One good way to judge a person, I find, is to ask myself: Would he be easy to work with and would I like to have him as my close associate?

Q. What part do first impressions play in your evaluation of people?

A. I think we all form a first impression when we meet anyone. Therefore, if a generally neat appearance is presented, I think it helps. It would indicate that you considered this important to yourself and had some pride in the way the interviewer might size you up.

Q. With only academic training as a background, how long will it be before I'll be handling responsible work?

A. Not long at all. If a man joins a training program, or is placed directly on an operating job, he gets assignments which let him work up to more responsible jobs. We are hiring people with definite consideration for their potential in either technical work or the management field, but their initial jobs will be important and responsible.

Q. How will the fact that I've had to work hard in my engineering studies, with no time for a lot of outside activities, affect my employment possibilities?

A. You're concerned, I'd guess, with all the talk of the quest for "well-rounded men." We do look for this characteristic, but being president of the student council isn't the only indication of this trait. Through talking with your professors, for example, we can determine who takes the active role in group projects and gets along well with other students in the class. This can be equally important in our judgment.

Q. How important are high scholastic grades in your decision to hire a man?

A. At G.E. we must have men who are technically competent. Your grades give us a pretty good indication of this and are also a measure of the way you have applied yourself. When we find someone whose grades are lower than might be expected from his other characteristics, we look into it to find out if there are circumstances which may have contributed.

Q. What consideration do you give work experience gained prior to graduation?

A. Often a man with summer work experience in his chosen academic field has a much better idea of what he wants to do. This helps us decide where he would be most likely to succeed or where he should start his career. Many students have had to work hard during college or summers, to support themselves. These men obviously have a motivating desire to become engineers that we find highly desirable.

Q. Do you feel that a man must know exactly what he wants to do when he is being interviewed?

A. No, I don't. It is helpful if he has thought enough about his interests to be able to discuss some general directions he is considering. For example, he might know whether he wants product engineering work, or the marketing of technical products, or the engineering associated with manufacturing. On G-E training programs, rotating assignments are designed to help men find out more about their true interests before they make their final choice.

Q. How do military commitments affect your recruiting?

A. Many young men today have military commitments when they graduate. We feel it is to their advantage and ours to accept employment after graduation and then fulfill their obligations. *We have a limited number of copies of a Department of Defense booklet describing, in detail, the many ways in which the latter can be done. Just write to Engineering Personnel, Bldg. 36, 5th Floor, General Electric Company, Schenectady 5, N. Y.* 959-8

***LOOK FOR other interviews discussing: • Advancement in Large Companies • Salary • Personal Development.**

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